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Summary

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INTRODUCTION

The bark paintings of Arnhem Land are perhaps the finest creations of contemporary Aboriginal art. Their technical excellence is combined with considerable stylistic variation across the region from east to west. In western Arnhem Land the background to the figures tends to remain free of infilling while the figurative representations are infilled; the opposite is practised in northeastern Arnhem Land. Infilling is not practised elsewhere in Australia (Morphy 1981: 56).

In general, bark paintings and other works of art are representations of the ancestral past (Dreamtime) when the world creators transformed the earth through their actions, creating the entire landscape as it is known to the Aborigines today — landforms, skies, flora, fauna, geography and social structures. The Ancestral Beings entrusted distinct areas of northeastern Arnhem Land to different clans for perpetuity (Morphy 1981: 59). The paintings are in many cases believed to be inherited from Ancestral Beings and they relate to them and the stories about their deeds on a number of levels with progressively deeper meaning.

Via connections between particular Ancestral Beings and distinct clans/moieties, a system of ownership or distribution of rights in paintings developed. In northeastern Arnhem Land these rights are exercised by patrilineal clans or their sections. A person also has some rights in the paintings of his mother's clan. Control over paintings and propagation of knowledge about

them belongs to the senior male members of the clan; learning the interpretation of designs is a part of male initiation (Morphy 1981: 57).

Aboriginal artists employ four colours — red, white, black and yellow — combining ochres, manganese oxides, charcoal, kaolin and other white materials with, originally, plant juice fixative. A sheet of bark is flattened with the help of fire and its surface smoothened. The surface priming is done by means of red, rarely black or yellow, ochre colour. Selected areas of the sketched design are infilled with cross-hatching. According to Caruana (1994: 26), cross-hatched clan designs are called *dhulang* in northeastern Arnhem Land. At first, the ground is covered with parallel white lines. A second set of lines is painted across it in white, red, yellow or black; sometimes also in an alternating colour sequence. Flat colouring is used as well; dotted patterns are infrequent.

The cross-hatching in two or more colours adds a radiating shimmer to the Aboriginal bark paintings (Morphy 1992); this brilliance technique is shared with the paintings of very few other cultures. The difference between the cross-hatched, shimmering areas and the flat-coloured patches is the fundamental means of artistic expression in the patterns treated in this study.

According to Morphy (1981: 64), the main components of northeastern Arnhem Land paintings are the ground colour, a border, dividing lines (compartments) and the figurative and geometric representations. The figures form a narrative scene that is often understandable

only to the initiated men and has different depths of meaning. The geometric elements are not iconic and an element can have a host of meanings depending on the context; its decoding requires prior instruction. The geometric patterns are owned by distinct clans; their similarities and differences reflect those between these social groups. The style of northeastern Arnhem Land is a product of combining two different (ie figurative and geometric) systems of representation (meaning) in one painting. Geometric elements are especially important for paintings created in closed context with a restricted, initiated audience.

There are two principal categories of geometric patterns in the bark paintings from northeastern Arnhem Land: two-coloured or multicoloured stripe patterns and similarly coloured diamond patterns; they rarely combine in striped diamonds.

The diamond patterns (owned by the clans of the Yirritja moiety) are the object of the present study. The richness and unparalleled sophistication of their colouring schemes appears worthy of a symmetrological/crystallographic study from at least two points of view. On the basis of our observations, we believe that the colouring is yet another, large-scale device to enhance the brilliance (the shimmering effect) of Yirritja bark paintings, and this unique artistic device deserves a more detailed description. On the other hand, this colouring might indicate the kinship between different clans and moieties. Thus far, only the overall pattern shapes have been invoked in the latter context (Morphy 1981: 62).

The studied material is primarily based on photographs collected by Prof. Howard Morphy prior to 1980 and unselfishly made available for the current project. This choice enabled the author to concentrate upon an older period of Aboriginal bark painting, preceding its present market context. It has been supplemented by observations made in the collections of the University of Western Australia and several thematic exhibitions as well as by published photographic material.

The author is aware of the limited size of the sample of material studied. However, the present paper is an exploratory analysis of the problem: its primary purpose is to investigate the feasibility of a symmetrological approach to the complex colouring schemes rather than producing definitive answers on their applicability to the kinship and inheritance problems.

SELECTED EXAMPLES

Figure 12, painted by a member of the Dhalwangu clan in 1975, contains two black-coloured long-necked tortoises in a 2-fold rotation arrangement on the back of a yellow tortoise; the high symmetry of the yellow tortoise body is broken only by its long neck. Water courses appear indicated by a cross-hatched striped pattern and tracks from tortoise feet. All are two-coloured on white background. Additional interpretations can be found in Morphy (1979: 309).

Four quadrants of the painting contain a diamond pattern outlined in yellow ochre and white frames and occasionally degenerated into a zig-zag. Investigating the periodicity of this pattern, we observe that the diamonds at the corners of a rectangular mesh are flat-coloured whereas the central diamond is cross-hatched. The flat-coloured diamonds are alternatively coloured red and black. The cross-hatched pattern is three-coloured, repeating the sequence white-red-white-black- (repeat). The resulting repetition period is a 4-fold of the basic one, a double of the flat-coloured sequence. The black-red alternation, occasionally also the red-yellow alternation on white background, dominates the painting.

The painting by a member of the Madarrpa clan (1975) in Figure 13 is compartmentalised perpendicular to its length into alternating striped, fish-populated 'water' portions and diamond-covered portions without iconic element. A broad-bodied crocodile occupies the entire long axis of the painting with enough space to depict its scales as a diamond pattern.

The black-red alternation dominates the painting. With one possible exception of one-coloured flat-coloured diamonds, the red-black exchange takes place perpendicular to the picture length. All cross-hatched patterns — those present as stripes or those included in the diamond fields — have a white-red-white-black- (repeat) colouring periodicity, parallel to the previous colour change. Diamond fields have non-diamond 'tails', giving the painting a forward thrust.

The two paintings by the Gumatj clan (1975) in Figures 14 and 15 offer multiple complications of the diamond scheme. Fig. 14 depicts a story of birds tracking along the picture and a goanna. The animals track across red and black striped fields on white cross-hatched background. Fields of diamonds occur in all four quarters, alone or as integral parts of a presumed landscape through which the birds track. The flat-coloured designs are either one-coloured (red) or, in the majority of

cases, show a red and black sequence. The cross-hatched patterns are either yellow-black sequences parallel to the previous ones or three-colour sequences with periodicity faults.

Figure 15 consists of a kangaroo attacked by a crocodile and, presumably, a large ray-fish, and presents an array of diamond colouring schemes. The attack itself takes place in a river, cross-hatched red and black on white background. The flat-coloured diamonds are mostly two-coloured,

red-black, red-ochre yellow, rarely only red. The arrays of cross-hatched patterns are more complicated: chessboard ochre and black or two-coloured black and yellow rows separated by white rows. The latter case again has two variations, according to a parallel or a chessboard scheme for the components of the coloured rows.

The Gumatj painting in Figure 1, produced in 1959-60, has one system of diamonds, changing to zig-zagging paths, all flat-ochre coloured.

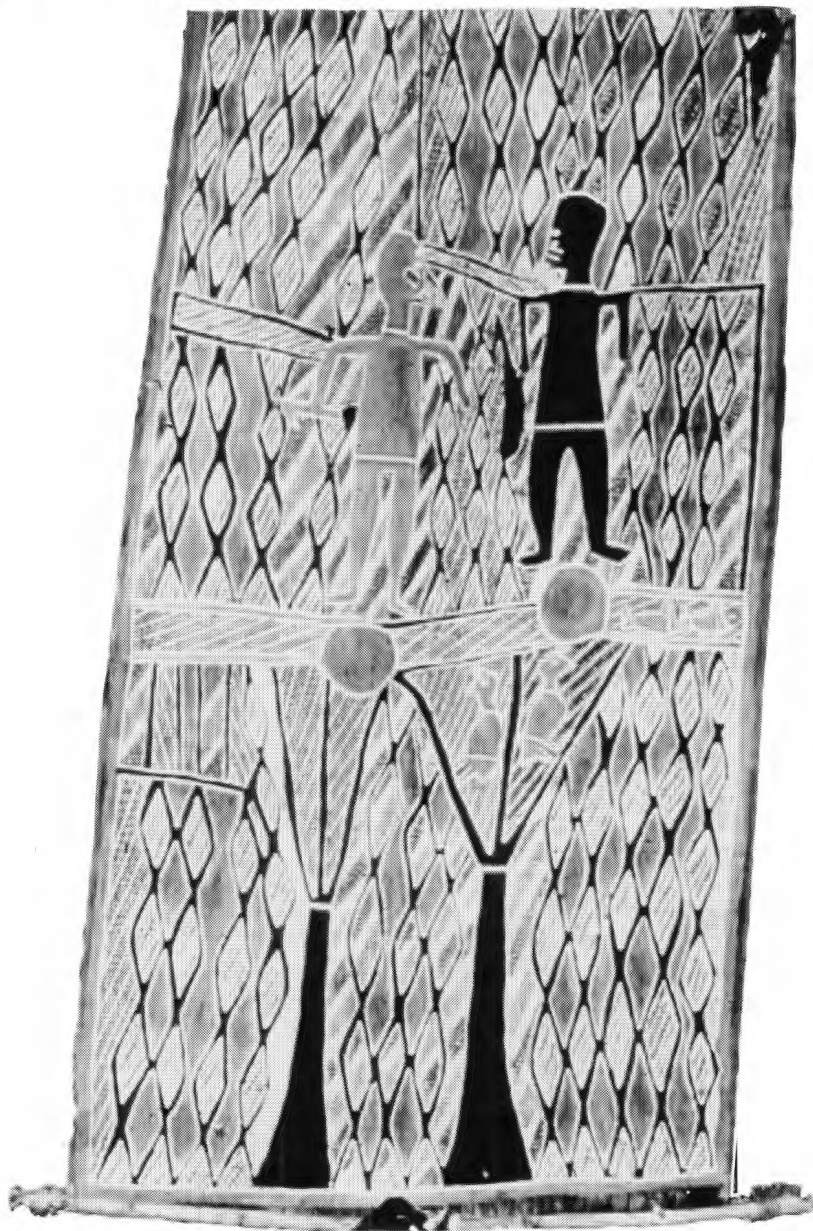


FIGURE 1. Bark painting by a member of the Gumatj clan (1959-60). Courtesy of H. Morphy.

Cross-hatched red and black striped areas with white background surround the black and ochre figures with spear throwers, separated from two black trees by a narrow river. The cross-hatched diamonds are one-coloured in the majority of fields (finely ochre and red ruled). In the uppermost main field, a unique sequence of colour-colour-white repeats; in the central lower panel three-coloured cross-hatched diamonds are present, coloured either parallel or antiparallel to each other.

The painting in Figure 2 (Gumatj clan 1975) recounts the story of a freshwater crocodile and fish in a red and white striped river. Three transversal compartments contain six diamond fields with rich ornamentation. All flat-coloured diamonds are one-coloured, red with expressive white frames. The cross-hatched diamond subset oscillates, by way of errors in repetition, between the three-coloured sequences black-red-white-black-red-white- (repeat) and black-red-white-red-black-white-black- (repeat), respectively;



FIGURE 2. Bark painting by a member of the Gumatj clan (1975). Courtesy of H. Morphy.

both of these are present as a sufficiently long pure sequence. A fragment of the sequence red-black-red-black- (repeat) and that of white-red-white-black- (repeat) (as well as pure cross-hatched white on the crocodile's back) have been employed as well. The former long colour sequences and the 'one-coloured' river stripes produce a colour impression very distinct from the previous examples.

These examples show a need for systematisation of coloured diamond patterns from northeastern Arnhem Land if further study is to be undertaken. The science of symmetry offers the most efficient means for such systematisation.

FUNDAMENTAL LANGUAGE OF SYMMETRY

The Aboriginal diamond patterns are by their nature two-dimensional periodic patterns. In such patterns a single motif (eg an individual lozenge) or motifs repeat infinitely. All repetitions of a given motif are related to each other by one or several exactly defined ways, called operations of symmetry. All symmetry equivalent motifs have the same shape and size and the same

surroundings from the point of view of symmetry and geometry. The symmetry-equivalent motifs can be related to each other by translation (pure displacement without a change in orientation), reflection (on a reflection axis in the plane of the pattern or on the reflection (= mirror) plane m perpendicular to the plane of the pattern, depending on the nomenclature used by the particular author; see Fig. 3e) or rotation (by an angle of $n/360^\circ$ around an n -fold rotation axis perpendicular to the plane of the pattern; the permitted values of n are 2, 3, 4 and 6; see Fig. 3a). A combination of reflection with translation (by half of the full repetition period of the periodic pattern) gives glide-reflection planes (axes) g (Fig. 3f).

From the infinite number of translation vectors between the periodically displaced copies of the same motif that can be found in a two-dimensionally periodic pattern, we usually select the two shortest ones. For the symmetries observed in the present work, these comprise an angle of 90° or quite a general obtuse angle and they are not equal in length and kind (eg Figs 3c,d; 4a; 5a,d). The two vectors define a parallelogram, by the translation (displacement) of

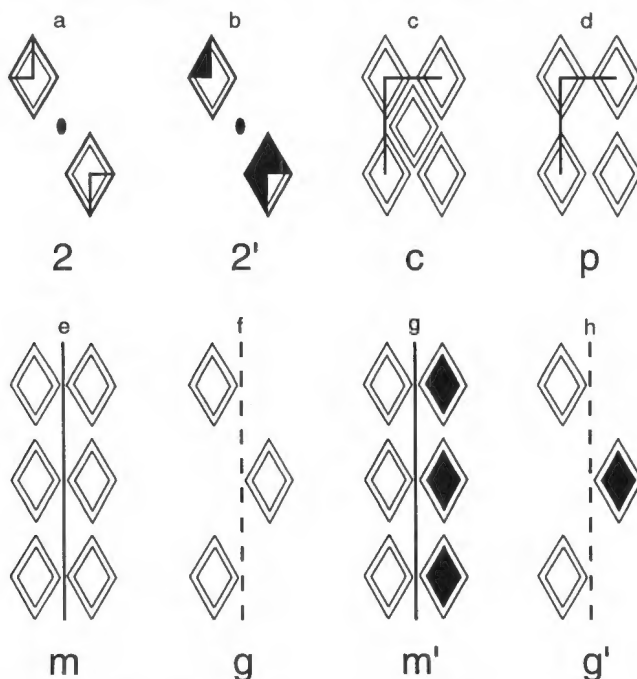


FIGURE 3. Fundamental elements of symmetry in Aboriginal diamond designs. Unmarked symbols (eg m) are colour-preserving elements whereas the primed symbols (eg m') are elements of dichroic symmetry; p and c — primitive and centred unit mesh with the a (vertical) and b (horizontal) axes indicated; 2 — twofold axis; m — mirror plane; g — glide reflection plane.

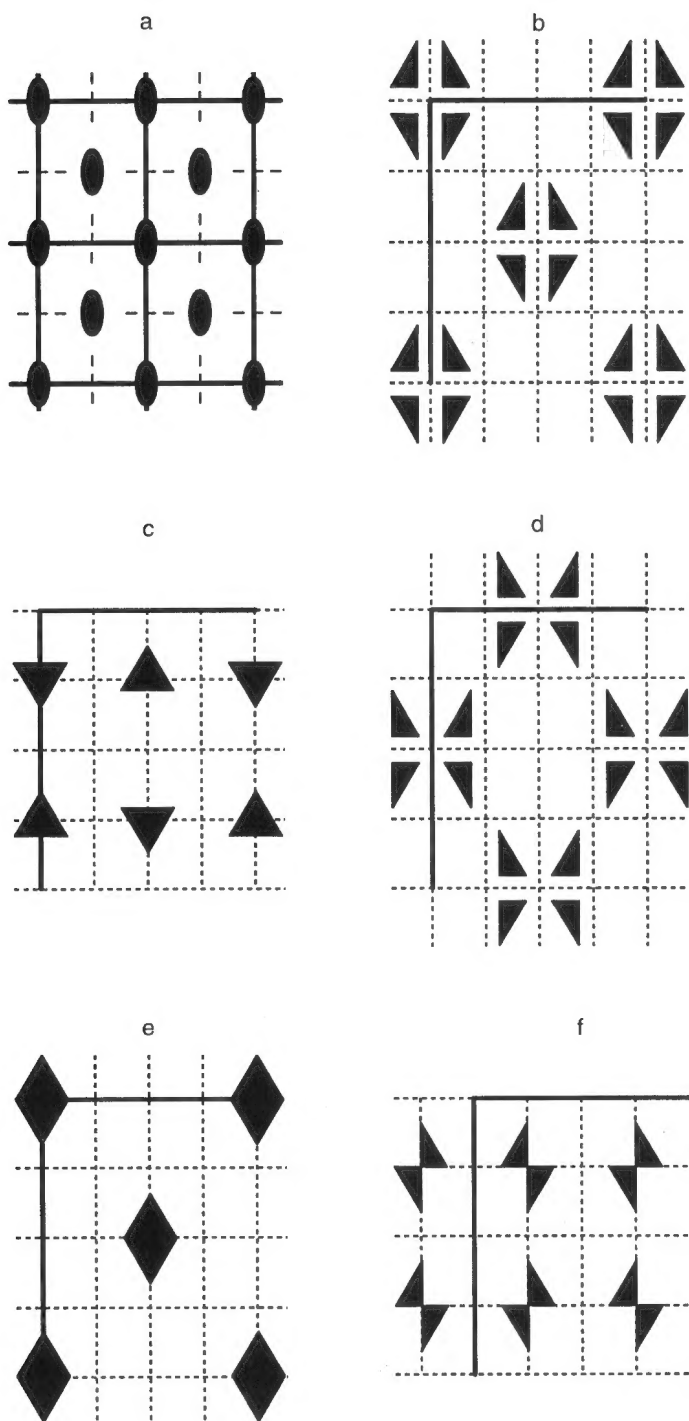


FIGURE 4. Plane group $cm\bar{m}$. **a**, reflection planes, glide-reflection planes and 2-fold axes in one unit mesh. In **b** to **f**, unit mesh axes (full lines) and position of symmetry planes (stippled) are indicated: **b** and **d** show an asymmetric motif in a general position and **c**, **e** and **f** show motifs in special positions (**c**, motif on reflection planes, **e**, motif on $2mm$ intersections, and **f**, motif on 2-fold axes; all motifs with appropriate own symmetry).

which the entire pattern can be reconstructed. This parallelogram is called a unit mesh (unit cell). The unit mesh is primitive when the translation-equivalent copies of the motif are only in its corners (Fig. 3d), or centred when an additional copy lies in its centre (Fig. 3c).

Only five basic shapes of unit mesh exist in planar patterns. All the patterns with a given type of unit mesh belong to the same system. These systems are as follows (a and b are the selected vectors, γ is their angle):

- i) Oblique ($a \neq b$, $\gamma \neq 90^\circ$); symmetry represents pure translations or translations and 2-fold axes
- ii) Rectangular ($a \neq b$, $\gamma = 90^\circ$, Figs 3d, 5e, 6a); symmetry elements present: reflection planes and glide-reflection planes that can be combined with each other and with 2-fold axes
- iii) Diamond (rhombic, centred rectangular) system which can either be described by a diamond-shaped mesh ($a = b$, $120^\circ \neq \gamma \neq 90^\circ$) or by a rectangular mesh with an additional translation-equivalent point in its centre, a so-called centred mesh ($a \neq b$, $\gamma = 90^\circ$, Figs 3c, 4a); relevant symmetry represents a combination of reflection and glide-reflection planes with or without 2-fold axes
- iv) Square ($a = b$, $\gamma = 90^\circ$); 4-fold axes combined with 2-fold axes with or without reflection and glide-reflection planes
- v) Hexagonal (equilateral triangular) ($a = b$, $\gamma = 120^\circ$); 3-fold axes with or without reflection and glide-reflection planes, or 6-, 3- and 2-fold axes with or without these planes of symmetry.

The second and third systems are most relevant for the present study; less frequent is the first one. For our diamond patterns, the γ angle of the oblique unit mesh is determined by the position and shape of the diamonds; if symmetry is ignored, metrically they are still rectangular. The hexagonal and square systems, so relevant for Islamic patterns (Abas & Salman 1995: 138; Makovsky & Makovsky 1977), are absent in Aboriginal art.

The operations of symmetry in the plane form unique combinations, the so-called plane (or two-dimensional) symmetry groups. Within these unique combinations of symmetry operations, any operation can be replaced by a combination of two or more other symmetry operations present in the given symmetry group. When two or more symmetry operations are combined, the result does

not depend on the sequence of operations chosen. Finally, any operation in the group has its inverse — a combination of a symmetry operation and its inverse results in a transformed motif which is identical to the original. Only 17 distinct plane groups of symmetry can be found in all two-dimensional patterns, from which four have been encountered in the present study. From the above listing of two-dimensional systems, the presence of certain rotation axes and, for some cases, the presence/absence of reflection planes in a plane group determines the geometry of unit mesh and the system to which the plane group belongs.

Books on symmetry written by mathematicians often start with abstract mathematical groups, then proceed to derive the two-dimensional groups of symmetry and do not always get down to the problems of their practical application. An exception is the book by Abas & Salman (1995), in which a profusion of examples with basic symmetrological information attached are given. A non-mathematical approach to plane groups is taken by Washburn & Crowe (1998: 58) in a book intended to teach anthropologists 'the symmetries of culture'.

Crystallographers are perhaps the most frequent practical users of symmetry groups. The approaches and notions used in the present paper come partly from this experience. The chapters on symmetry in crystallographic textbooks range from highly mathematical (but always practical) to almost purely geometric; the reader can find an understandable/complete approach to plane groups in Klein (2002).

The crystallographic notation of plane groups used here consists of 4-place symbols. The first letter p or c denotes primitive or centred mesh, respectively (Figs 3c,d); the integer ' n ' denotes the highest order of rotation (2-fold rotation for the present cases); the next letter denotes a mirror plane m or a glide-reflection plane g perpendicular to the a axis (which points downwards in each figure); and the following letter indicates such planes perpendicular to the b axis (which points to the right) (Figs 4, 5, 6).

Thus, for example, cmm denotes a centred mesh with mirror planes perpendicular to the mesh axes a and b ; $p2$ denotes a primitive mesh with a 2-fold rotation axis; and pgg denotes a primitive mesh with glide reflections perpendicular to axes a and b (see Fig. 5).

The trivial factors (the directions to which no perpendicular symmetry planes exist) are omitted in the abbreviated symbols commonly used. They would have been denoted by '1' on the relevant

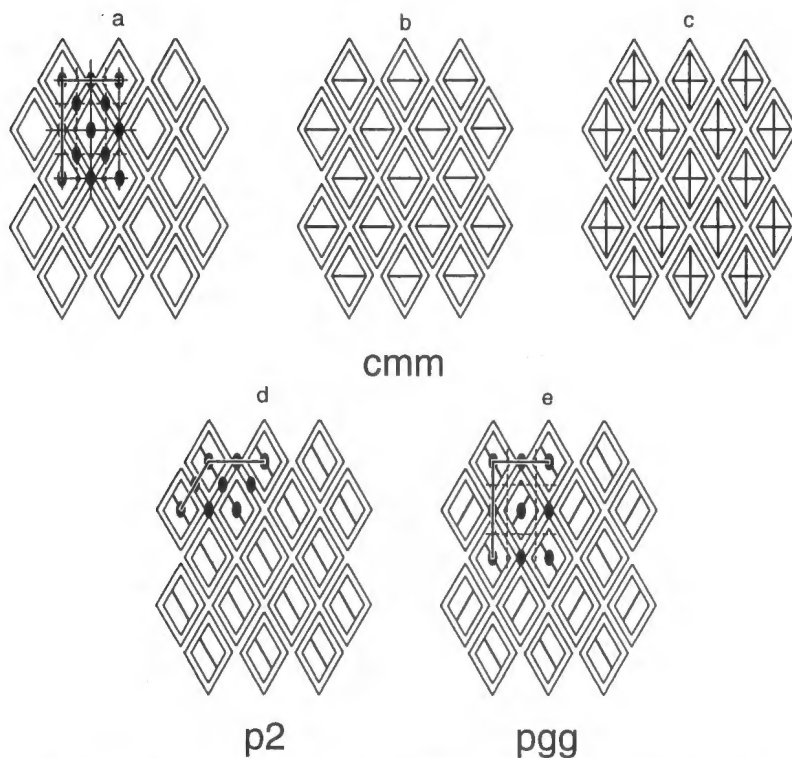


FIGURE 5. **a**, uncoloured diamond pattern with unit mesh and the plane group *cmm* indicated. **b** and **c**, pattern of halved and quartered diamonds, respectively (**a** and **b** contain special positions, **c** general positions). **d** and **e**, uncoloured diamond patterns with oblique partitioning: **d**, plane group *p2*, **e**, plane group *pgg*. In this and the following figures, the *a* axis of the mesh points downwards, the *b* axis to the right.

position of a full symbol. Other rules of notation are valid for the square and hexagonal systems, with 4-, 3- and 6-fold axes, which were not encountered in this study.

Application of plane groups of symmetry does not require their (re)derivation, but depends critically on their correct interpretation. In this connection, division of elements of the motif into those placed in general positions (not situated on any element of symmetry) and in special positions (situated on an element of symmetry or in an intersection of several elements of symmetry) is of the most fundamental importance although it is rarely mentioned outside the field of crystallography. An element (ie motif) in the special position ought to have symmetry at least equal to the symmetry elements on which it is positioned. If its symmetry is lower, it reduces the overall symmetry of the pattern; if it is higher, it may result in stacking errors in the design. An element in general position is asymmetric by virtue of its position. If it has any other symmetry, it again can lead to errors in pattern periodicity.

As an example, the elements of, and the general and special positions in, the plane group *cmm* are illustrated in Figure 4. This group has a centred unit mesh and two sets of mirror planes, respectively perpendicular to the *a* and *b* axes. As can be seen in Fig. 4, these 'principal symmetry elements', which form part of the plane group symbol, are interleaved by glide-reflection planes. Two-fold axes occur on intersections of all symmetry planes of the same kind.

If the patterns encountered in the present study are studied on the uncoloured level (as field-and-line patterns) they are reduced to the patterns shown schematically in Figure 5. In the fundamental type, Fig. 5a, the framed diamonds can occasionally become squares or be partitioned into halves (Fig. 5b), but nearly all Aboriginal artists use the simple diamond grids from Fig. 5a.

In this pattern, each diamond is in a special position of the plane group *cmm*, on the intersection of two mirror planes and a 2-fold axis. Its shape (own symmetry) corresponds to this site symmetry (Fig. 5a). When the diamond is

symmetrically divided into two halves (Fig. 5b), each of these is still in (another) special position, straddling a mirror plane. When it is divided into four quarters (Fig. 5c), these are in general positions and, as a consequence, each of them is asymmetric.

If two opposite edges of a diamond element have been accentuated by a colour stripe (as done by the Aboriginal artists in some instances), its symmetry is reduced to 2-fold rotational only and the mirror planes are lost. The two simplest arrangements yield symmetry groups $p2$ and pgg (Fig. 5d,e, in which the edge stripes were enlarged to fill the entire halves of the diamond field).

We shall see that in the process of colouring, the Aboriginal artists often made consecutive rows of diamonds non-equivalent and effectively separated them from each other by giving them different colour sequences, symmetries and periodicities. Each subset of this kind has symmetry pmm before colouring is applied (Fig. 6a). If two opposite edges of each diamond are accentuated, subsets with symmetries cmm , pgm (both with a larger unit mesh) and $p2$ (Fig. 6b) result.

A simple extension of groups of symmetry can be achieved when a change of colour of the element (ie diamond) acted upon is assigned to each step of a particular operation of symmetry. A change of colour from 'white' to 'black' (and back in the next step) can be assigned to translations, centration, or 2-, 4- or 6-fold rotation, as well as to the reflection and glide-reflection planes. Such operations are called operations of antisymmetry and the symmetry groups are called dichroic or black-and-white, or groups of antisymmetry. In the case of two-dimensional

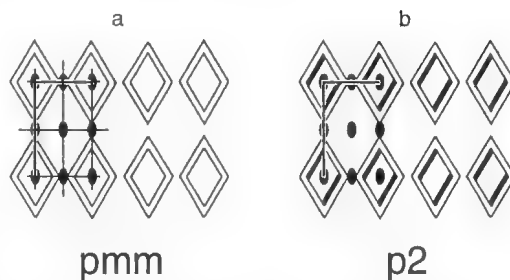


FIGURE 6. Two examples on an uncoloured diamond subset: a, plane group pmm , b, plane group $p2$.

periodic patterns in plane, 46 plane groups can be discerned when the above 17 uncoloured plane groups are not counted. In the symbols the colour-changing symmetry operators are primed, the colour-unchanging ones are left unprimed (Figs 3b,g,h).

The above discussed diamond patterns with symmetries cmm , pmm , pgg , pgm and $p2$ can yield a number of dichroic patterns. Examples are given in Figs 7–9. Several of them will be discussed in detail here.

Figures 1, 2 and 12–15 show dichroic patterns in which the diamonds at the vertices of the unit mesh are coloured in one way (flat colour) whereas those in its centre are coloured in a different way (cross-hatched). If these two styles of colouring are interpreted as black and white, respectively, this general colour scheme is identical with that in Fig. 7b. Using the cmm pattern in Figs 4a and 5a as reference, we can see that the following symmetry operations became colour-changing operations: the translation from the origin to the centre of the unit mesh, the glide-reflection planes and one half of 2-fold rotation axes (ie those along the lozenge edges). On the

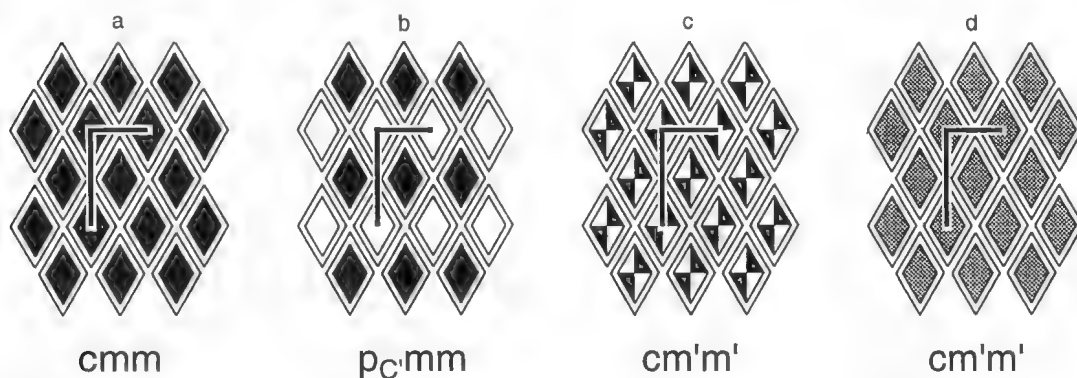


FIGURE 7. Dichroic plane groups for selected diamond patterns: a, the basic one-coloured pattern, b, $pcmm2$ with special positions, c, $cm'm'$ with general positions, d, ditto with a special position only.

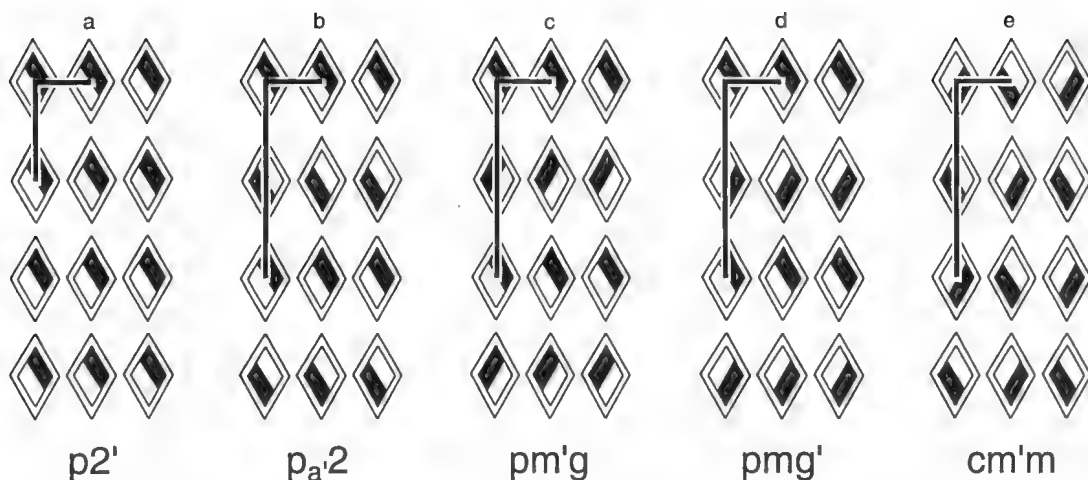


FIGURE 8. Dichroic colouring of a $p2$ diamond pattern: **a**, dichroic plane group $p2'$, **b**, p_a2 , of the pmg pattern: **c**, $pm'g$, **d**, pmg' ; and of the cm pattern: **e**, $cm'm$.

other hand, the 'principal symmetry elements' which enter the group symbol, ie the two systems of reflection planes, the other half of rotation axes and the translations along the unit-mesh edges, remain colour-preserving. Thus, this dichroic group can be described by the symbol p_cmm2 , where C' denotes the colour-changing operation of mesh centration.

On the other side of the spectrum is a $cm'm'$ pattern (Fig. 7c), in which both systems of mirror planes and the associated glide-reflection planes change colour on reflection, whereas the centration vector and all 2-fold rotation axes (cf Fig. 5c) preserve the colour of elements they act upon. Pattern in Fig. 7c shows general positions

for this group; that is, each lozenge is cut up into four parts which do not lie on any symmetry elements and could even be moved apart as in Fig. 4d of the uncoloured parent group. The colour of special positions, on m' planes or on $2m'm'$ intersections, can be obtained by lumping the appropriate two or four quarters together and averaging their colour. They will be grey, with both black and white components present at the same time, and therefore will remain unchanged even if subjected to colour-changing operations of symmetry (Fig. 7d).

As a final example, the two simplest dichroic colourings of the $p2$ pattern shown in Figs 5e and 6b result in the patterns in Fig. 8a,b. In the first

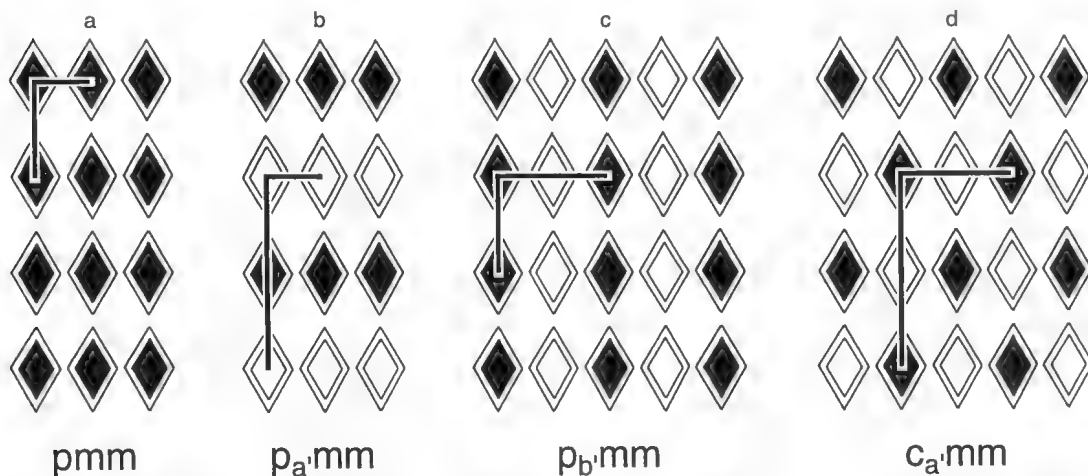


FIGURE 9. **a**, monochroic and **b-d**, dichroic, colouring of the pmm diamond subset; **b**, $p_a'mm$, **c**, $p_b'mm$ and **d**, $c_a'mm$.

case all 2-fold axes become colour-changing, resulting in symmetry $p2'$, whereas in the second case only half of their set will represent colour-changing operators. The latter case can be conveniently described as a doubling of one of the unit-mesh edges by a colour-changing translation, in this case as $p_a.2$. The cases based on the plane groups pmg and cmm give a broader spectrum of dichroic colouring (Fig. 8c–e).

A rectangular pmm example in Fig. 9a that can be coloured by a two-coloured translation b' or a' as $p_a.mm$ or $p_b.mm$ (Fig. 9b,c) leads towards a generalisation of this process for more than two colours, and to the simplest type of coloured groups of symmetry in which colours of all (or selected) elements of a pattern change periodically along one translation direction. Along this colour-modulation direction the fundamental translation of the pattern will change to its n -tuple for the sequence of n colours involved.

Thus, trichroic modulation of the pmm pattern of diamonds will result in a trichroic plane symmetry group with a tripled b -translation (Fig. 10). If we study the chromaticity (colour action) of mirror planes perpendicular to the colour-modulated b direction as well as that of 2-fold axes, we find that it is only partial for this case. These symmetry elements alternate only two colours, leaving the third one unchanged. The resulting plane group symbol is correspondingly complicated, $p_b^{(3)}mm^{(2,1)}2^{(2,1)}$. Superscripts in round brackets indicate the number of permuted colours and, following the comma, the number of unchanged colours. When ignoring the symmetry of the underlying pattern, this plane group can be simplified to $p_b^{(3)}m1$; in this case the colour scheme employed is presented as simple vertical

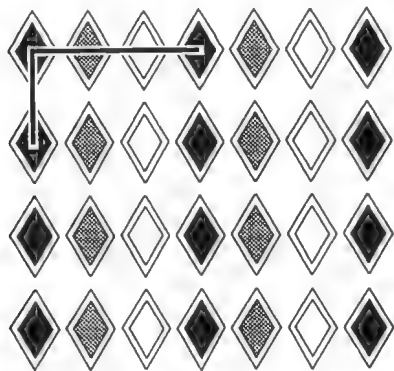


FIGURE 10. Trichroic modulation of the pmm diamond subset; trichroic plane group $p_b^{(3)}mm^{(2,1)}2^{(2,1)}$.

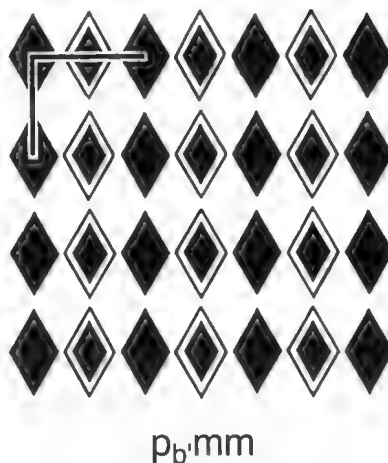


FIGURE 11. Diamond pattern from a crocodile's back. Gumatj bark painting. Colouring of diamonds is interpreted by a dichroic plane group.

colour stripes overlying the correspondingly coloured diamonds. Extension of the dichroic $c_a.mm$ principle in Fig. 9d to more colours is much more complicated; it can be seen, for example, on the cross-hatched diamonds of the drawing in Fig. 17f.

CLASSIFICATION OF OBSERVED DIAMOND PATTERNS

The observed diamond patterns can be classified according to the following properties of the colouring schemes employed by Aboriginal artists:

- i) maximally two colours, black and red are used for flat-coloured diamonds, plain white being consistently avoided; the flat-coloured diamonds are either all of one colour or they are simply two-colour modulated
- ii) one to three colours have been used for the cross-hatched diamonds — either the vector of the colour-modulation wave is parallel to the b axis, or the wave is diagonal to the two axes of the pattern; in rare cases, the colour modulation vector is parallel to the a axis.

The resulting classification is given in Table 1.

THE OBSERVED SYMMETRY GROUPS

As remarked earlier, the entire body of coloured diamond patterns suggests that, on the whole, the flat-coloured and the cross-hatched subsets are treated independently from each other. Their

TABLE 1. Colouring schemes observed for the two component subsets in the Aboriginal diamond patterns.

Colour type	Polychroism * (colour index)	Mesh size * & type	Wave-vector of colour modulation and coloured plane group	Expansion by intervening neutrally coloured stripes of diamonds parallel to <i>a</i>
Flat-coloured	1	$a \times b$ p	wave-vector undefined pmm	—
Flat-coloured	2	$a \times 2b$ p	b $p_b mm$	—
Flat-coloured	3	$a \times 3b$ p	b $p_b^{(3)} mm^{(2,1)} 2^{(2,1)}$	—
Cross-hatched	1	$a \times b$ p	wave-vector undefined pmm	—
"	2** 2***	$a \times 2b, p$ $a \times 4b, p$	b b $p_b mm$	— yes
"	3	$a \times 3b$ p	b $p_b^{(3)} mm^{(2,1)} 2^{(2,1)}$	—
"	3	$a \times 6b$ p	b $p_{b2}^{(3)} mm 2$	—
"	2 2***	$2a \times b, p$ $2a \times 2b, p$	a a $p_a mm$	— yes
"	2 2***	$2a \times 2b, c$ $2a \times 4b, c$	diagonal diagonal $c_a mm$	— yes
"	3	$3a \times 3b, p$	diagonal $p_a^{(3)} b^{(3)} 2^{(2,1)}$	—

Notes:

a axis runs parallel to the long diagonals of diamonds.

b axis runs parallel to the short axis of diamonds, at 90° to the *a* axis.

Colour index indicates the number of alternating colours. Mesh size is expressed in terms of the fundamental, uncoloured periodicities. Wave-vector of a colour modulation wave is a vector perpendicular to the consecutive coloured rows; its length is equal to that of a complete colour permutation. Coloured plane groups are explained in the text.

* Expansion by intervening, neutrally coloured (in the observed cases white) stripes of lozenges parallel to the *a* axis always expands the *b* parameter by two fundamental *b* lengths.

** For the special case of a sequentially dichroic sequence, with the *a* axis expanded by the white diamonds of the first colouring stage, see text.

*** One more (neutral) colour, which is not counted into the colour index of the colour group, is present in the pattern.

coloured plane groups are summarised in Table 1. From the symmetrological viewpoint, only the three simplest combinations of flat-coloured and cross-hatched diamonds can be treated as one whole; artists might have done it for these simple cases as well:

a) The simplest colouring of the diamond pattern, in which both the flat-coloured and the cross-hatched components have only one colour each (Fig. 16a) can be described, as was done in the section on symmetry, by means of the dichroic plane group $p_c mm 2$.



FIGURE 13. Bark painting by a member of the Madaripa clan, 1975. Courtesy of H. Morphy.



FIGURE 12. Bark painting by a member of the Dhalwangu clan, 1975. Courtesy of H. Morphy.



FIGURE 15. Bark paintings by a member of the Gumatj clan, 1975. Courtesy of H. Morphy.



FIGURE 14. Bark paintings by a member of the Gumatj clan, 1975. Courtesy of H. Morphy.

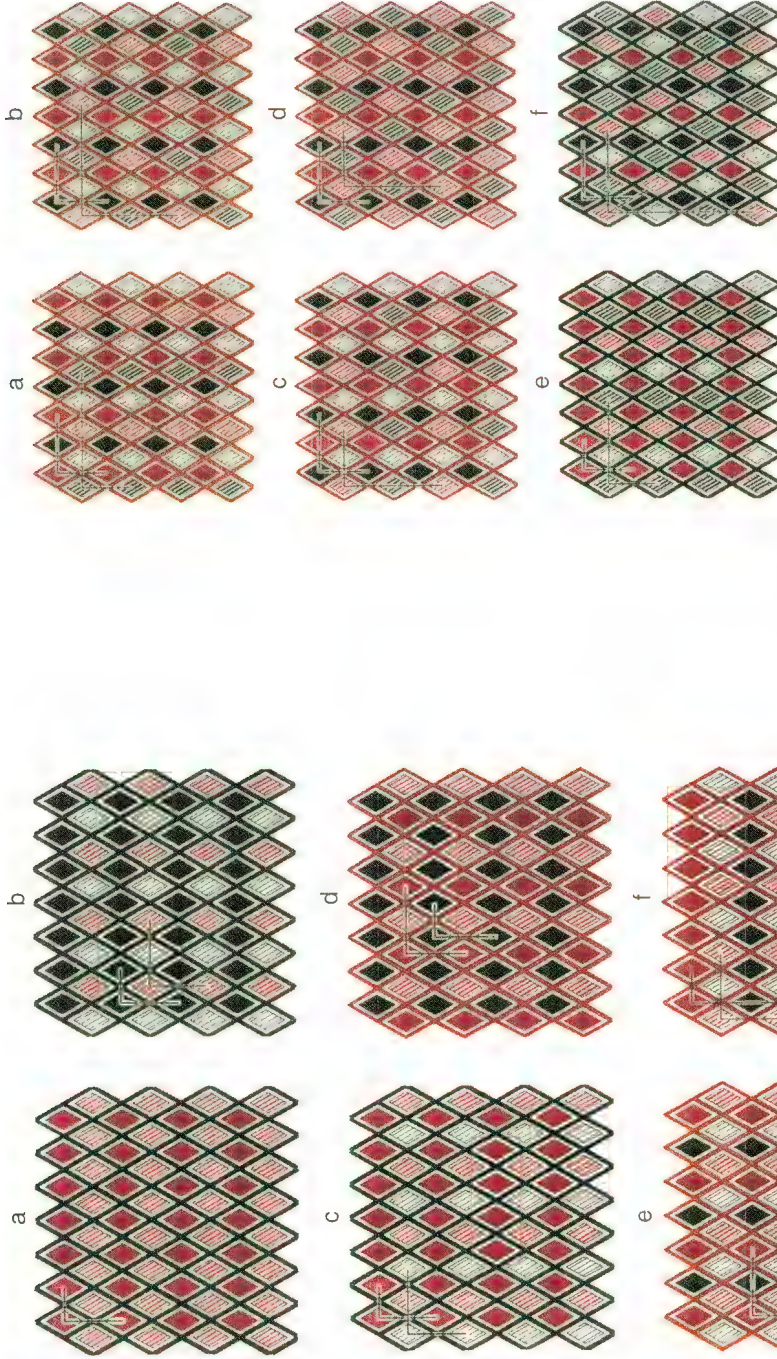


FIGURE 16. Observed colouring combinations for diamond patterns from the northeastern Arnhem Land. **a**, flat-coloured subset: pmm , cross-hatched subset pmm ; full pattern p_bmm2 (Dhalwangu); **b-d**, different instances of pmm and p_bmm2 subsets, respectively; full pattern p_bmm2 (**b**, Madarrpa, **c**, Gumatj and **d**, Dhalwangu); **e**, both subsets p_bmm2 , full pattern p_bmm2 (**f**, p_bmm2 and p_bmm2 , respectively).

FIGURE 17. Further colouring varieties of diamond patterns from northeastern Arnhem Land. **a**, p_bmm for a flat-coloured subset, p_bmm with intervening colour-neutral white diamonds for a cross-hatched subset (Gumatj); **b**, p_bmm and c_bmm , respectively, with intervening white colour-neutral diamonds (Dhalwangu); **c**, p_bmm for the flat-coloured subset; p_bmm for the non-white half of the cross-hatched subset (a sequentially dichroic cross-hatched sequence; Gumatj); **d**, p_bmm and a 'dark' non-interspaced version of the cross-hatched subset with plane group c_bmm (Gumatj); **e**, monochromatic pmm combined with three-coloured $p_bmm^{(1)mm^{(2,1)}}$ (Gumatj); **f**, p_bmm , and $p_bmm^{(1)mm^{(2,1)}}$ with a three-coloured wave (110) (ie wavefronts span the end of the a vector and the end of the $-b$ vector of the unit mesh) (Gumatj).

- b) A monochromatic pattern (Fig. 16b,c,d) ($a \times b$) of the flat-coloured subset can be described by the uncoloured plane group $pmm2$. However, it can also be incorporated into the dichroic cross-hatched component (red- and white-hatched diamonds) of the pattern as its special positions on colour-changing mirror planes and 2-fold axes. The single flat colour can then be understood as a balanced mixture of two pure, hatched colours from general positions and therefore it does not change when translated by the colour-changing translation $b'/2$.

Thus, this pattern taken as a whole has the same dichroic symmetry, $p_b.mm2$, as its cross-hatched portions. The colour-changing operators are the $b/2$ translation and the mirrors and 2-fold axes situated at $b/4$ and $3b/4$.

- c) The only other pattern still described by a single unit mesh and symmetry group is the dichroic pattern in Figure 16e. In this pattern both components are colour-modulated, with the wave vector of the modulation parallel to the b axis. Each component taken alone would have symmetry $p_b.mm2$, but the entire pattern (with the phase shift between the modulation of the flat-coloured and the cross-hatched components equal to $1/2 b$ of the underlying $a \times b$ lozenge pattern) has symmetry $p_b^{(2)}.mm^{(2,1)}2^{(2,1)}$. None of the components is in a special position in respect to the coloured translation $b/2$.

For all other cases, amalgamation of the two components of the pattern into one whole either leads either to a significant loss of the symmetry information needed to describe the colouring schemes devised by the Aboriginal artist (especially the $a \times 2b$ modulation of the flat-coloured component), or yields unrealistically large repetition periods.

Therefore, separation of the two components of the pattern is natural to, and the only proper representation of, the colouring schemes designed by the Aboriginal painters. The contradiction of the two subsets creates a pleasant internal tension (large-scale shimmer) in the pattern, arrests the eye of the beholder and leads him to an intentional or unintentional analysis of the not too overloaded colouring scheme. The pleasure of the colour contrasts and of the recognition process is similar to that felt by beholders of good modern abstract paintings.

The majority of complex patterns in which the two-coloured subsets have unit cells of unequal

size nearly always display the same mesh and symmetry for the flat-coloured red and black subset ($a \times 2b$) $p_b.mm2$; the rare exception $p_a.mm2$ is in Fig. 16f. The mesh size and coloured plane groups differ widely for the cross-hatched subset; it is primarily the sequences with dichroic symmetry that are observed. The dichroic plane groups $p_b.mm2$, $p_a.mm2$ (the colour change being perpendicular to that in the flat-coloured component in this case) or $c_a.mm2$ (eg Fig. 17b) occur according to the direction of the colour-modulation wave. Most of them occur in an expanded version in which the b parameter of the unit mesh is expanded by the width of two colour-preserving ('neutral') white-hatched diamonds. The latter represent special positions between every consecutive, red-black and black-red pair of lozenges situated in general positions (Fig. 17a,b in the above sequence).

The highest colour index (number of alternating colours) observed for the cross-hatched component is three (a white-red-black repetition), with the colour modulation vector parallel to b . In Fig. 17e this unit mesh ($a \times 3b$), with the space group $p_b^{(3)}.mm^{(2,1)}2^{(2,1)}$ is combined with the monochromatic flat-coloured mesh ($a \times b$) $pmm2$.

More difficult is the case of white-black-red-white-red-black-white black- (repeat) cross-hatched sequence attempted in the Gumatj painting in Fig. 2. The resulting b axis is a sextuple of the fundamental one: the $b/2$ parameter is three-coloured and the mirror plane perpendicular to b at 0 and $1/2 b$ is uncoloured, reflecting (ie reversing) the colour sequence. Thus, the complete description is $p_{(b/2)}^{(3)}.mm2$.

In the already mentioned, rare, trichroic case from the Gumatj clan (Fig. 17f), the colour modulation wave is parallel to the diagonal of the fundamental uncoloured mesh. Its oblique mesh ($a' \times 3b$; $a' = a + b$ of the fundamental uncoloured mesh) has symmetry $p_b^{(3)}2^{(2,1)}$. If, as an alternative, the axes of the hatched pattern are selected as three-coloured sequences parallel to the axes of the flat-coloured mesh, the resulting coloured mesh is rectangular $p_a^{(3)}p_b^{(3)}2^{(2,1)}$. The colour modulation vector, perpendicular to the diagonal modulation wave, is equal to $3b - a$ of the fundamental mesh.

THE USED VERSUS UNUSED SYMMETRY COMBINATIONS

Even being limited only to the rectangular and oblique systems and ignoring, in agreement with

the Aboriginal artists, the additional colouring possibilities which arise in the case when diamonds turn into squares and the underlying pattern belongs to the square system, comparison of the possible colouring schemes (plane groups) with the actually used ones reveals the very restricted choice the Aboriginal artists have made.

As we have seen, the fundamental uncoloured (or one-coloured) lozenge sets have symmetries cmm , pmm , pgg , pgm or $p2$. From the first two plane groups, the following categories of dichroic plane groups with unchanged basic translation vectors can be derived: $cm'm$, $cm'm'$, p_cgg , p_cmm and p_cgm from cmm , and $pm'm$ and $pm'm'$ from pmm . For a doubled a parameter, the plane groups $p_a mm$, $p_c mg$ (and their permutation for the doubled b parameter), and for doubled a and b parameters $c_a mm$, can be added. Some of them are illustrated in Figs 7–9, 16 and 17, and the remaining ones can be found in Washburn & Crowe (1998). Whereas $c_a mm$ and $p_a mm$ (or its rotated version, $p_b mm$) can occur both with whole diamonds of one colour or with diamond halves coloured oppositely, some of the symmetry groups require symmetric division of each diamond into two or four oppositely coloured portions (Figs 7, 8). As a rule, such division (known, eg, from the Acoma Pueblo pottery (New Mexico), Mehinaku and other tribes in Brazil, and Turkoman carpets of Central Asia) was almost never attempted by the Aboriginal artists. Thus, all groups with colour-changing mirror planes (which may not transpire from the group symbol because it only shows the colour-preserving g planes parallel to them) fall out and we are left with just the three rectangular plane groups of symmetry described from bark paintings, ie $p_a mm$ ($p_b mm$), $p_c mm$ and $c_a mm$ (Figs 7, 9). The only exception, which has colour-changing mirror planes, is the occurrence of the overall dichroic group $p_b^{(2)} mm^{(2,1)} 2^{(2,1)}$ (Fig. 16e) mentioned above. It is based on the uncoloured group pmm , and the lozenges in the central horizontal row of its mesh are non-equivalent to those situated on the a and b vectors. It might be better to divide this pattern into two independent components, both with symmetry $p_b mm$, in line with the other patterns of the series and, perhaps, in agreement with the understanding of its structure by the artist himself.

The trichroic plane groups used by Aboriginal artists are only of the simplest type. They are based on a juxtaposition of colour stripes that results in a unidirectional colour modulation (ie periodic colouring) of the underlying geometric pattern. Beside the cases when the modulation

vector is parallel to the axes of the fundamental mesh (Fig. 17e), the above mentioned more complicated case of diagonal waves has been worked out by the Gumatj artist (Fig. 17f). However, the corpus of potential, but unused, trichroic combinations is large.

DISCUSSION AND CONCLUSIONS

The present study has examined the applicability of more exact crystallographic methods to Aboriginal art studies. Its preliminary results were summarised in the general paper by Makovicky (1986) and presented in Perth in 1987. Since then, some concepts have been revised and new material added.

The advantages of using plane groups of symmetry for analysis of larger bodies of ornaments are indisputable today (Abas & Salman 1995; Makovicky 1989; Makovicky & Makovicky 1977; Makovicky & Fenoll 1997). The description of coloured ornaments by means of dichroic or polychromatic groups of symmetry is less widespread but equally effective (Makovicky 1986; Makovicky & Fenoll 1999; Washburn & Crowe 1998:63). On the one hand it gives a shorthand notation for the colouring schemes applied, and on the other it allows the identification of colouring sequences built on the same principle, notwithstanding the colour combinations or element shapes used. For example, the Aboriginal colour sequences red–white, black–red and red–yellow are described by the same dichroic plane group (Fig. 16e,f), expressing the same colouring intention as well. Dichroic or polychromatic groups of symmetry are the best tool for further analysis of distinct sequences based on the same underlying pattern, as in the present case.

Symmetrological analysis shows that black, red and ochre yellow always play a role in colour alternation/permutation in Aboriginal patterns, whereas the role of white is varied. It is not used as a flat colour; in its cross-hatched form it either represents yet another regular colour (in sequences such as red–white, black–red–white– (repeat) (Fig. 17e) or red–yellow–white– (repeat)) or it is the neutral colour interspaced in colour sequences, in principle dichroic, such as white–red–white–black–white– (repeat), eg Fig. 17a. The latter case can also be interpreted as a sequentially dichroic sequence in which the cross-hatched subset is divided into a white and a non-white subset; the latter subset is further divided into two distinctly coloured subsets of diamonds. The second

colouring step can take more fanciful forms — it can be centred, as in Fig. 17b, or periodic at a right angle to the first step, as in Fig. 17c. The rare occurrence of these sequences in Aboriginal paintings is in contrast to their common occurrence elsewhere (Makovicky 1986; Makovicky & Fenoll 1999).

Lack of green and blue earthy pigments undoubtedly contributed to the four-colour palette and colour sequences of Arnhem Land artists. Another technical limitation which might have played a role in the choice of colouring schemes/sequences (coloured plane groups) is the size of bark surfaces available and of the fields into which they were traditionally divided.

The symmetrological results of the present study are satisfactory: the artistic canon of the Yirritja diamond patterns can be successfully and exactly described by means of coloured symmetry groups and colour modulation waves. However, the number of bark paintings available for this study does not allow us to reach the other goal of this investigation, that of potentially associating the distinct colouring schemes with different clans of the Yirritja moiety. However, the present investigation has defined all the necessary means for such a follow-up study based on detailed investigations in the field and in museum collections.

What are the preliminary results obtained from the limited material? At present, it appears that the Dhalwangu clan uses preferably one- and two-coloured sequences, resulting in the plane groups shown in Fig. 16a,c–f; one suggestion of a $pmm/p_b^{(3)}mm^{(2,1)}$ combination (as in Fig. 17e) was seen. The version in Fig. 17a with interspaced white cross-hatch is important, both in the red–black and red–yellow varieties.

The Madarrpa clan uses similar simple patterns, such as those in Figs 16b,c,e and 17a. However, in the work of Wakuthi Marawili in 1982, the palette explodes into a spectrum of $p_b^{(3)}mm^{(2,1)}2^{(2,1)}$ sequences for both the flat-coloured and the cross-hatched subsets. Placing the ‘starting’ block of one subset next to that of the other subset and running the colour permutations in the same directions in both subsets, a very effective colour scheme has been devised (Caruana 1994: Fig. 56). A combination of the same flat-coloured 3-fold sequence as above with a two-coloured white-interspaced cross-hatched sequence p_bmm rims this bark painting. The same artist created a panel with patterns such as those in Figs 16e and 17d for the Berndt Museum of the University of Western Australia.

The Gumatj bark paintings contain the most complicated examples of colouring. Starting with a monochromatic flat-coloured subset, patterns in Figs 16a,c and 17e (with stacking faults in the colouring sequence) are observed. With a bi-coloured flat-coloured subset, powerfully coloured versions of Figs 16e and 17a were designed; well used also is the pattern of Fig. 17c with the two colour-modulation directions at right angles to each other. The chessboard-based pattern of Fig. 17d is accompanied by imperfect versions of the patterns of Fig. 17b,f. A particular type of pattern reproducing that of a crocodile’s back is in Fig. 11. Faults in three-coloured cross-hatched sequences are frequent, sometimes making the interpretation of the depicted panels ambiguous.

Patterns with partitioned diamonds are infrequent. A rare example with the black flat-coloured subset possessing a longitudinal partition and constructed according to the schemes in Fig. 16a,c, and a pattern similar to that of Fig. 17a, but with one-coloured flat-coloured elements, comes from the Munyuku clan (Morphy 1979: 304).

Only rare examples were seen of diamond patterns with diagonally or parallel three-striped diamonds. A faultless $p2'$ pattern of this type was painted by J. Wululu, central Arnhem Land (Yirritja, in Caruana 1994); a mixture of $p2'$ (even p_b2), and p_gm' (due to faults in colour sequence) from Gupapuyngu clan (Milingimbi, Arnhem Land, 1963) is reproduced by Cooper et al (1981). A similar mixture of $p2'$ and p_b2 is found in a Gumatj pattern (Fig. 1) from 1959–60; and a faultless combination of flat-coloured (dotted) pmm and cross-hatched $p2'$ in a Gupapuyngu (1948) pattern, both photographed by H. Morphy. Apparently, these examples are fairly marginal to the entirely cross-hatched striped sequences of other clans, eg Marrakulu, Manggalili, Rirratjingu (Morphy 1981: 63; Caruana 1994: 64–67), as well as of those from central Arnhem Land.

Although the amount and breadth of material studied limits severely the validity of our conclusions, it appears that there exist observable clan-specific differences in the latitude of designs used. However, they are easily transcended in the production of especially talented bark painters, such as W. Marawili of the Madarrpa clan. Without doubt, the largest frequency of complex designs occurs in the paintings by members of the Gumatj clan. To the contrary, the Dhalwangu creators of exceptionally powerful turtle paintings used their basic pattern language to a great advantage without complicating it by more complex colour schemes.

How old are the diamond designs? Old examples are rare; the Dhalwangu example from 1952 (Sutton 1990: 21) contains the same colouring combinations (coloured plane groups) as the new paintings (Figs 16a,c,e). Other Dhalwangu examples from 1948 contain the same patterns. Gumatj painting from 1959 to 1961 contains a pattern of the Fig. 16c type. The assertion is that the coloured diamond patterns are traditional (Morphy 1981: 62) and may have had their origin in contacts with Macassan trepang fishermen who brought Indonesian utilitarian art (eg patterned fabrics) with them (Mulvaney 1981: 16). The symmetrological independence of the northeastern Arnhem Land diamond patterns, and of their colouring, from the original Macassan examples is apparent from a perusal of Indonesian textile patterns, which are largely based on symmetries other than those used by Arnhem Land artists.

From a symmetrological point of view, the majority of studied Aboriginal coloured diamond patterns have a unique character. In several cultures a dichroic division of elements into a white and a coloured subset was common, with the former left intact and the latter again divided into two differently coloured subsets. These patterns were defined as sequentially dichroic by Makovicky and Fenoll (1999); examples from different cultures (especially Islamic and Old Egyptian) are given in Makovicky (1986). The Arnhem Land Aborigines acted differently in most

instances. With the exception of the simplest patterns, illustrated in Fig. 16b–d, both of the two primary subsets (ie the flat-coloured and the cross-hatched) are further dichroically or trichroically subdivided. Only the cross-hatched sequences in Fig. 17a–c, with rows of white 'colour-neutral' diamonds, were produced by the process of sequentially dichroic colouring.

In conclusion, with powerful dichroic and trichroic sequences, Aboriginal artists created a unique dynamic whole in which the two different periodicities produce a captivating internal tension and a wonderfully shimmering colour effect. The overall impression can be described as two quite different colour waves transcending the same complex pattern. They are in contrast to the simple colouring of the animals, persons and objects that supply the narrative of the painting.

ACKNOWLEDGMENTS

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SHALLOW-WATER CUMACEAN CRUSTACEA FROM AUSTRALIA AND LOMBOK (INDONESIA): FAMILIES BODOTRIIDAE AND LEUCONIDAE

U. MÜHLENHARDT-SIEGEL

Summary

Twenty species are identified from the families Bodotriidae and Leuconidae from 39 shallow-water stations around Australia and one location in Indonesia. Of these 20 species, two are possibly conspecific. One species of the genus *Leptocuma* has to stay in open nomenclature because of the poor condition of the specimen. The genus with the most species is *Cyclaspis* with 11 representatives in the samples. Two of them, *Cyclaspis ursulae* sp.n. from the exsculpta-group and *Cyclaspis lissa* sp.n., are new to science; *Cyclaspis strumosa* and *C. cf. strumosa* are also discussed. A new species of the genus *Mossambicuma* is described. This genus has been monotypic since Day (1978) described it from the western Indian Ocean. New species are also described for the genera *Leptocuma*, *Glyphocuma*, *Pocrocuma* and *Bodotria*. Only one representative of the family Leuconidae was found, in Tasmania, extending the distribution of that species, *Ommatoleucon ocularis*.

SHALLOW-WATER CUMACEAN CRUSTACEA FROM AUSTRALIA AND LOMBOK (INDONESIA): FAMILIES BODOTRIIDAE AND LEUCONIDAE

U MÜHLENHARDT-SIEGEL

MÜHLENHARDT-SIEGEL, U. 2003. Shallow-water cumacean Crustacea from Australia and Lombok (Indonesia): families Bodotriidae and Leuconidae. *Records of the South Australian Museum* 36(1): 21–57.

Twenty species are identified from the families Bodotriidae and Leuconidae from 39 shallow-water stations around Australia and one location in Indonesia. Of these 20 species, two are possibly conspecific. One species of the genus *Leptocuma* has to stay in open nomenclature because of the poor condition of the specimen. The genus with the most species is *Cyclaspis* with 11 representatives in the samples. Two of them, *Cyclaspis ursulae* sp.n. from the *exsculpta*-group and *Cyclaspis lissa* sp.n., are new to science; *Cyclaspis strumosa* and *C. cf. strumosa* are also discussed. A new species of the genus *Mossambicum* is described. This genus has been monotypic since Day (1978) described it from the western Indian Ocean. New species are also described for the genera *Leptocuma*, *Glyphocuma*, *Picrocuma* and *Bodotria*. Only one representative of the family Leuconidae was found, in Tasmania, extending the distribution of that species, *Ommatoleucon ocellaris*.

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Following the comprehensive studies of Herbert Hale from 1928 to 1952 (Hale 1928, 1936, 1937, 1944, 1945, 1948, 1952) on Cumacea from Australia, very little work was done on these Crustacea in this region until Tafe & Greenwood (1996) did their investigations at Moreton Bay, Queensland.

The family Bodotriidae comprises 31 genera, five of them endemic to Australian waters. The Bodotriidae genus with the most species is *Cyclaspis* with 118 species, many (46%) of them described from Australia. Despite the comprehensive and intensive studies of the authors mentioned above, even more undescribed species remain. The descriptions of two of these are given here. For detailed generic diagnosis and subdivision of the genus see Tafe & Greenwood (1996) and for synonyms see Bacescu (1988).

The other genera mentioned in this study are *Bodotria* (Atlantic, Indian and Pacific oceans), *Leptocuma* (Australia and West Atlantic), *Mossambicum* (Western Indian Ocean, Mozambique), *Glyphocuma* (Australia), *Picrocuma* (Australia) from the family Bodotriidae and *Ommatoleucon* (Australia) from the family Leuconidae.

using a hand net by Prof. Dr. G. Hartmann and Dr. G. Hartmann-Schröder during their expedition to Australia September 1975 to February 1976:

Western Australia

- WA sample 10, Broome, 10 September, fine sandy eulitoral
- WA samples 14+15, Broome, close to Willie Creek
- WA samples 17+18, Derby, 20 September, silty lower eulitoral
- WA sample 23, Broome, 24 September, mangroves
- WA sample 27, Port Hedland, 27 September, close to low tide, fouling
- WA sample 28, Port Hedland, 27 September, fine sand on reef top
- WA sample 30, Port Hedland, 28 September, silty clay, mangroves
- WA sample 35, Port Samson, 30 September, sand and algae, coarse sand and mud
- WA sample 37, 7 km east of Dampier, Horsines Cove, 2 October, shell hash – sand, mangroves
- WA sample 39, Dampier, 3 October, fine sand eulitoral, in front of tidal flat edge
- WA sample 46, 24 km south of Exmouth, 10 October, fine sand, eulitoral, between reefs
- WA sample 66, Drummonds, close to Geraldton, 21 October, fine sand

MATERIAL AND METHODS

Material collected in shallow coastal waters

WA samples 67+68, Jurien close to Cervantes,
24 October, sand

South Australia

SA sample 126, Port Lincoln, Proper Bay,
4 December, sand and seagrass

SA sample 129, Port Augusta, 6 December,
mangroves, silt and shell hash

Victoria

VIC sample 148, Foster, Port Welshpool,
28 December, mangroves, soft silty sand

VIC sample 165, southern dead end of Clarence
River, near Yamba, 18 January 1976,
brackish water and mangroves.

Additional unidentified material was available
from the South Australian Museum, Adelaide:

Various stations, Noosa R., 40 mesh tow net, June
1940, leg. ISR Munro;

Whiting Ground, Waterhouse Bay, east end
Thistle Island, 4 March 1931, 8 – 8.3
fathoms;

North end Herald Bight, Shark Bay, 3 fathoms,
sand, 'Isobel' W.H., 21 November 1945,
submarine light, temperature: 24.22° C;

Whalers Bay, Thistle Is., 3 February 1941,
submarine light, leg. K. Sheard;

Near Pt. Maclaren, Thorny Passage, Whiting
Ground, 3.5 fathoms, 8–8.30 pm, 2 March
1941, submarine light, leg. K. Sheard.

Material collected by Dr. V. Siegel and the
author, shallow subtidal water:

Tasmania

TAS Nubeena, 6 November 1995, soft silty sand
with detritus

TAS Marion Bay, 5 November 1995, fine sand
and sea grass

Queensland

QLD, Lizard Island 1992:

11 November, mangroves, 0.1 m, soft sand

12 November, Turtle Bay, 15 m, sand

13 November, sand, 10 m

14 November, Turtle Bay, 16 m, coarse sand

15 November, Turtle Bay, 15 m, soft sand

17 November, Mermaid Bay, 7–10 m

17 November, sand, 7 m

18 November, North Reef, 19 m, sand

19 November, Lagoona, 7 m, sand

19 November, Watson's Bay, 17 m, sand

19 November, sand, 2 m

20 November, Pidgin Point, 12 m

20 November, Watson's Bay, 16 m

21 November, South Reef, 12 m

Material collected by Dr. J. Martens and Dipl.
Biol. U. Heuer:

Indonesia, Lombok, Plankton/Neuston, 9 March
1996, 0–10 cm.

The material is deposited at the Zoological
Museum of the University of Hamburg (ZMH) or
in the South Australian Museum, Adelaide
(SAM).

SYSTEMATICS

Order CUMACEA Kröyer, 1846

Family BODOTRIIDAE T. Scott, 1901

Subfamily BODOTRIINAE T. Scott, 1901

Genus *Bodotria* Goodsir, 1843

Bodotria cf. *biplicata* Gamô, 1964

(Figure 1)

Material

Lombok: 1 juvenile male; ZMH K 39930.

Remarks

The juvenile male (1.5 mm in length) has
the pleopods barely developed; the total
length is about half as long as the holotype
(2.7 mm). Its two lateral carinae and the
dorsomedian carina are well marked in the
anterior half, the pitted structure of the
carapace makes the individual similar to *B.*
pulchella (Sars, 1878). It is differentiated
from *B. pulchella* by the unsegmented
uropod's endopod, which makes it likely to
be conspecific with *B. biplicata*.

Distribution

Japan, Korea and Indonesia.

Bodotria cf. *minuta* Kurian, 1961

(Figure 1)

Material

Lombok: 1 juvenile female; ZMH K 39929.

Remarks

The juvenile female in the collection has the
uropods' rami missing. It fits quite well with
Kurian's (1961) description: carapace without
carinae, first free pereopod small, in the present
female not as free as in adult female, pigment
spots present, as figured by Kurian.

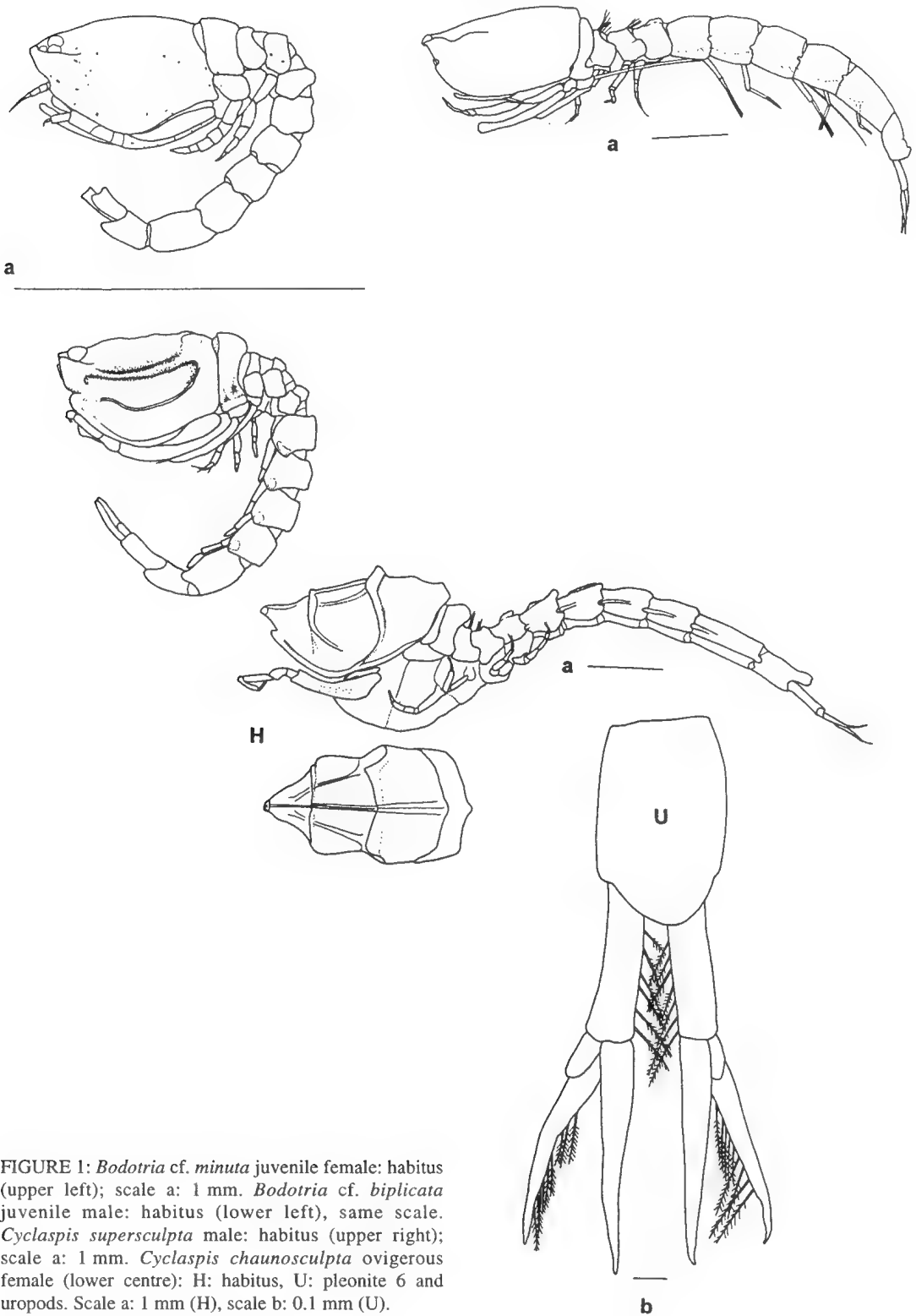


FIGURE 1: *Bodotria cf. minuta* juvenile female: habitus (upper left); scale a: 1 mm. *Bodotria cf. biplicata* juvenile male: habitus (lower left), same scale. *Cyclaspis supersculpta* male: habitus (upper right); scale a: 1 mm. *Cyclaspis chaunosculpta* ovigerous female (lower centre): H: habitus, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (U).

Distribution

Southern India and Indonesia.

Bodotria unacarina sp.n.

(Figures 2 and 3)

Material

WA: 35: 1 subadult male, 1 subadult female, 1 juvenile.

QLD: Lizard Island 1992: Turtle Bay (15 November, 15 m): 2 juvenile females; Pidgin Point: 1 subadult male, 1 juvenile female; ZMH K 39931; sand (2 m): 3 ovigerous and 2 subadult females, 1 male, 10 juveniles; SAM C 5996.

Holotype: ovigerous female SAM C 5995a, SAM C 5995b: extremities of paratype

Paratypes: 2 ovigerous females, 2 subadult females, 1 male (dissected), SAM C 5996

Leg.: V. Siegel & U. Mühlenhardt-Siegel

Date: 19 November 1992

Locus typicus: Australia, Great Barrier Reef, Lizard Island, sand (2 m).

Diagnosis

Bodotria with one lateral carina in female, uropod's endopod unsegmented, 11 and one terminal setae on endopod in male, two median and one terminal setae in female, no scaly structure on carapace, uropod's peduncle longer than endopod in male.

Description

Based on holotype, ovigerous female, 2.2 mm length in total:

Carapace with a dorsomedian carina and one lateral carina on each side, proportion length to height 1.6, length to width 1.2. Pseudorostrum shorter than length of ocular lobe; siphonal tube moderately long; dorsomedian line straight; antennal notch narrow; anterolateral margin smooth.

Integument granulose; eyes with six lenses. First free thoracic segment not visible, the second pedigerous segment longer than following, free segments combined shorter than carapace, lateral carina continued on second pedigerous segment, third to fifth segment with lateral plates.

Abdomen 1 mm in length, a little shorter than carapace and free thoracic segments combined, pleonite 6 proportion length to width 1.2.

Description of extremities is based on paratype, ovigerous female:

First antenna geniculated, basal article longest, middle article shortest, main flagellum two-segmented, distally with two aesthetascs and one

seta, accessory flagellum rudimentary, only three setae visible; mandible pars incisiva with three teeth, between pars incisiva and pars molaris 11 setae.

Maxilliped 2 long basis, merus outer margin dilated, carpus and propodus equal in length, longer than merus, dactylus with stout terminal seta; maxilliped 3 basis longest article, with short distal prolongation, not reaching articulation between ischium and merus; ischium longer than merus, merus with short terminal prolongation, carpus distally geniculated, propodus and dactylus subequal in length, terminal seta stout, exopod present (not figured).

Pereiopod 1 basis longer than rest of extremity, carpus second longest article, propodus and dactylus subequal in length, dactylus half as wide as propodus, exopod present; pereiopod 2 basis longer than rest of extremity, covered with hair-like setae, ischium missing, merus and carpus equal in length, propodus short, dactylus tapering with one terminal and two subterminal setae; pereiopods 3 to 5 similar in shape, the hinder extremities getting shorter due to diminishing length of basis; uropod's endopod unsegmented, one long and one short seta at inner margin, one terminal seta, peduncle longer than pleonite 6 (length proportion 1.7) and endopod (length proportion 1.6), exopod a little shorter than endopod.

Male with five pairs of well developed pleopods, 2.8 mm in length, abdomen longer than carapace and free thoracic segments combined, pseudorostral lobes meeting in a point in front of ocular lobe, abdominal segments larger than in female; proportions of peduncle to pleonite 6 is 1.1, peduncle to endopod 1.2, pleonite 6 length to width 1.4. Bases of first two pedigerous extremities longer than in female, uropod's peduncle with ten long and seven shorter setae, endopod with nine spine at inner margin, additional one terminal and one subterminal spine, exopod with 11 long plumose setae at inner margin and one strong terminal seta.

Etymology

The new species is named after its most striking morphological character, the single lateral carina.

Remarks

Bodotria species with unsegmented uropod's endopod, one lateral carina, and proportion of pleonite 6 length to width close to 1.2, as in the new species are: *B. arenosa* (Goodsir, 1843) from the northeastern Atlantic; *B. armata* Tafe &

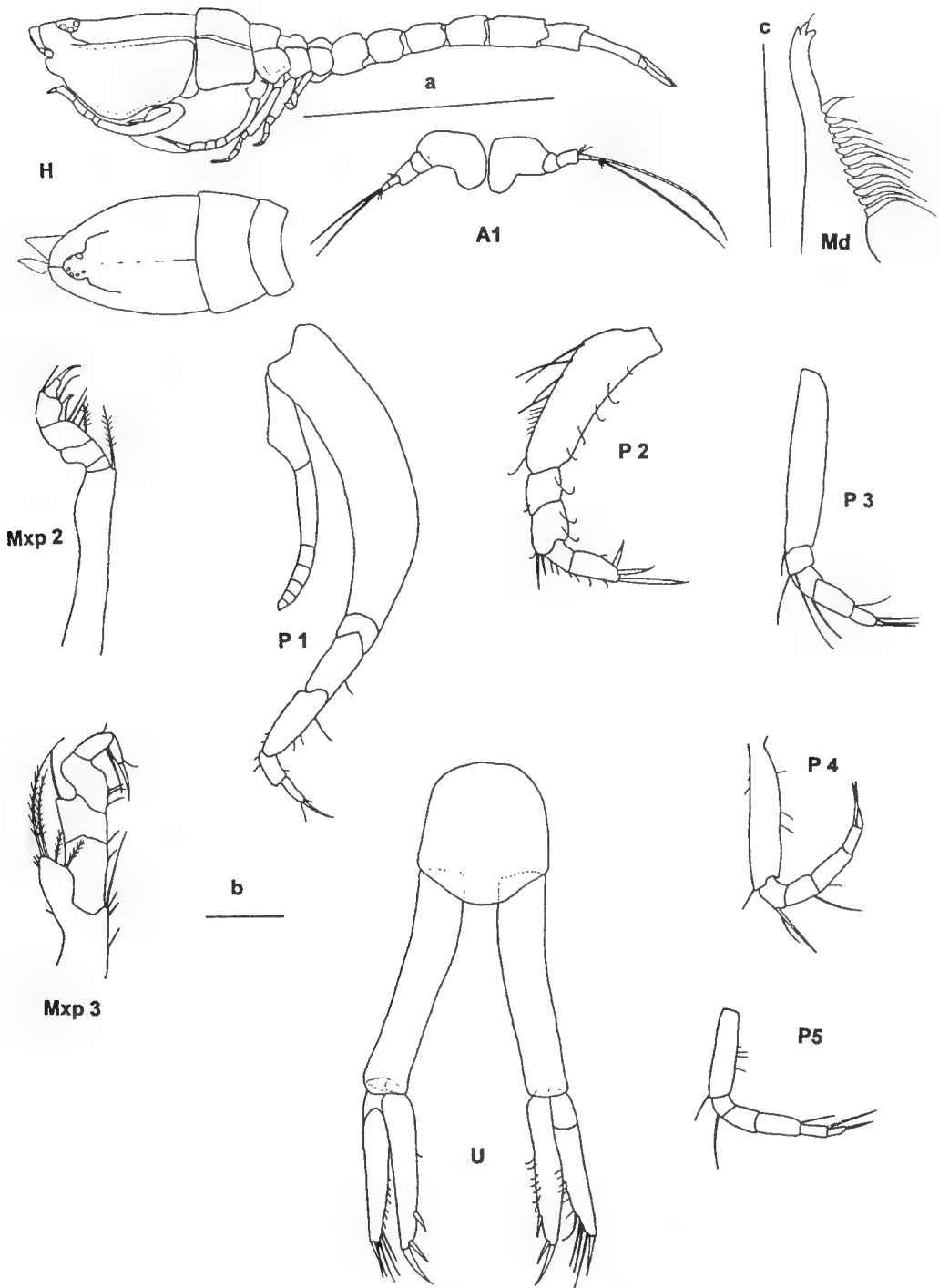


FIGURE 2: *Bodotria unacarina* sp.n. ovigerous female: H: habitus female, A1: first antenna, Md: mandible, Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (A1, Mxp2, Mxp3, P1, P2, P3, P4, P5, U), scale c: 0.1 mm (Md).

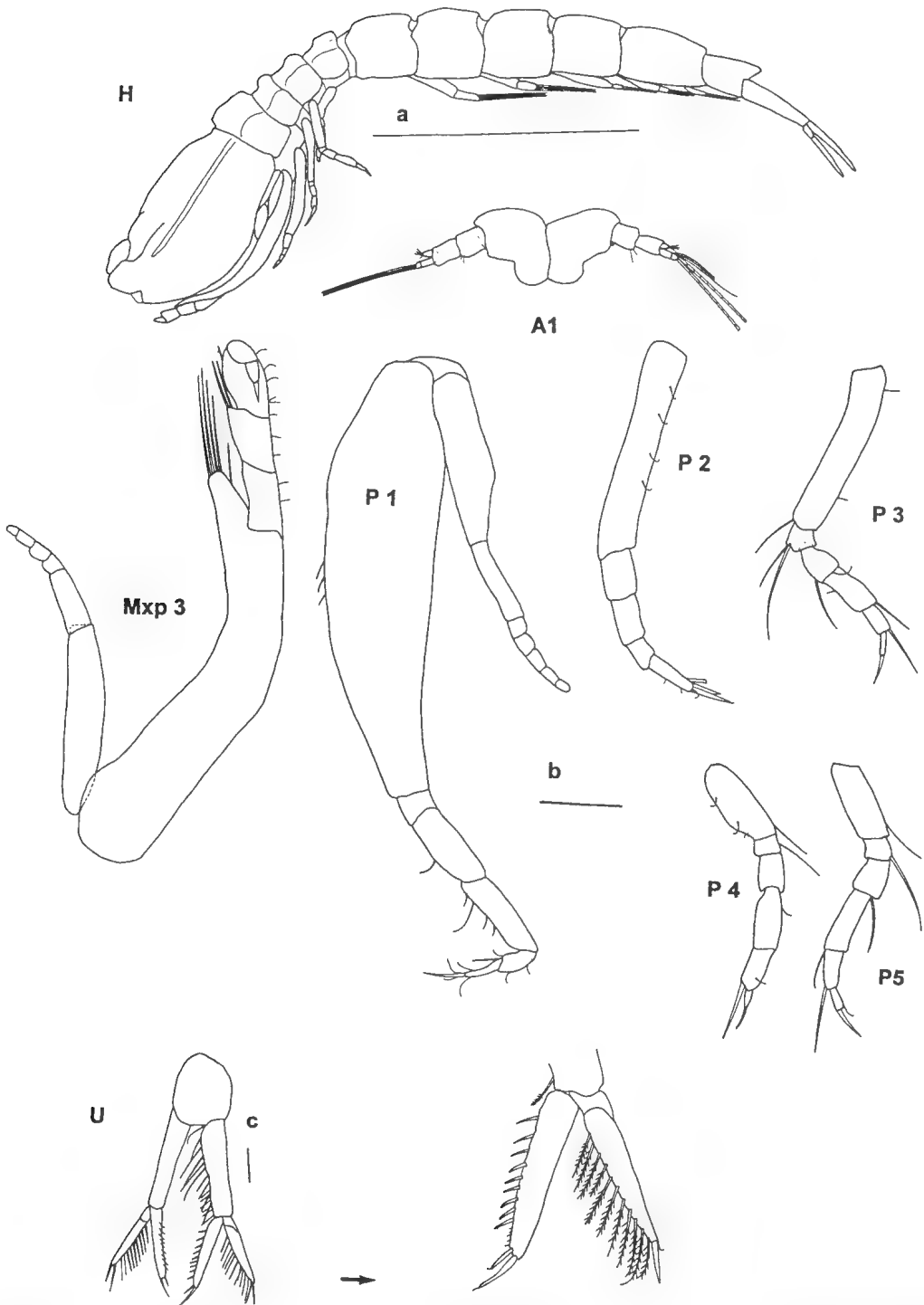


FIGURE 3: *Bodotria unacarina* sp.n. adult male: H: habitus, subadult male A1: first antenna, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (A1, Mxp3, P1, P2, P3, P4, P5, U enlarged), scale c: 0.1 mm (U).

TABLE 1: Comparison of some characters of selected *Bodotria* species with unsegmented uropod's endopod, n.d.: no data.

	<i>Bodotria arenosa</i>	<i>Bodotria armata</i>	<i>Bodotria armata</i>	<i>Bodotria rugosa</i>	<i>Bodotria serrata</i>	<i>Bodotria unacarina</i> n.sp.	<i>Bodotria unacarina</i> n.sp.
sex	male	female	male	female	male	female	male
lateral carina	1	1	1	1	1	1	1
Proportions							
pleonite 6 length:width	1.3	1.2	1.2	1.3	1.1	1.2	1.4
peduncle:pleonite 6	1.7	1.5	1.6	1.2	2.5	1.7	1.1
peduncle:endopod	1.5	1.4	n.d.	1.2	1.6	1.6	0.9
pedigerous segment visible?	—	?	?	+	?	—	—
setae at endopod	4+1	?	11+1	2+2	13+2	2+1	11+1

Greenwood, 1996 from Moreton Bay, Queensland; and *B. rugosa* Gamô, 1963 and *B. serrata* Harada, 1967 from Japan (Table 1). The new species resembles *B. arenosa* with respect to the females' length proportions of the uropod's peduncle to pleonite 6 and endopod, respectively. It differs from that species in the number of setae on the endopod. The new species differs from the geographically close species *B. armata* in missing the scaly structure of the integument, and the length proportions peduncle to endopod and to pleonite 6. The female's length proportion of peduncle to pleonite 6 is 1.5 in *B. armata* and 1.7 in *B. unacarina* sp.n., and the proportion of peduncle to endopod is 1.4 in *B. armata* and 1.6 in *B. unacarina* sp.n. The male's length proportions of peduncle to pleonite 6 are 1.6 in *B. armata* compared to 1.1 in *B. unacarina* sp.n. The differences between females of the new species and *B. rugosa* are the relatively longer uropod's peduncle relative to pleonite 6 and endopod in the new species. The differences between males of the new species and *B. serrata* is the relatively shorter uropod's peduncle.

Genus *Cyclaspis* Sars, 1865

Cyclaspis caprella Hale, 1936 (Figure 4)

Material

TAS: Nubeena: 1 subadult, 2 ovigerous females; ZMH K 39917.

Remarks

Hale (1936) described the male of his new species from Yorke Peninsula, South Australia, and emended the description for the males from

the same location (Hale, 1944). He mentioned the females (Hale, 1944) and gave a short description and a few figures of the females from Kettering, Tasmania (Hale, 1948). Additional figures of the females' extremities are given herein. The species is easily identified by the anterior 'horns' formed by the acute anterolateral corners, narrow ocular lobe with terminal eye, pseudorostral lobes not meeting in front of the ocular lobe, strongly elevated second pedigerous segment, fourth and fifth pedigerous segments with a pair of triangular teeth on dorsum, the first pleonite with a strong procurved tooth on each side near the dorsal posterior end. The uropod's exopod has two apical mucrones, as mentioned by Hale (1944).

Cyclaspis chaunosculpta Tafe & Greenwood, 1996 (Figure 1)

Material

QLD: Lizard Island 1992: Lagoon (7 m): 1 female with developed oostegites; ZMH K 39920.

Remarks

The habitus of the specimen fits quite well with the figure in Tafe & Greenwood (1996). Additionally, pleonite 6 and uropods are figured (Fig. 3). The carapace structure of the Lizard Island specimens seems to have smaller sponge-like pits than in the Moreton Bay specimens.

Cyclaspis cottoni Hale, 1937 (Figure 5)

Material

TAS: Marion Bay: 3 ovigerous females, 4 adult and 5 subadult males; SA: 126 (Port Lincoln): 1

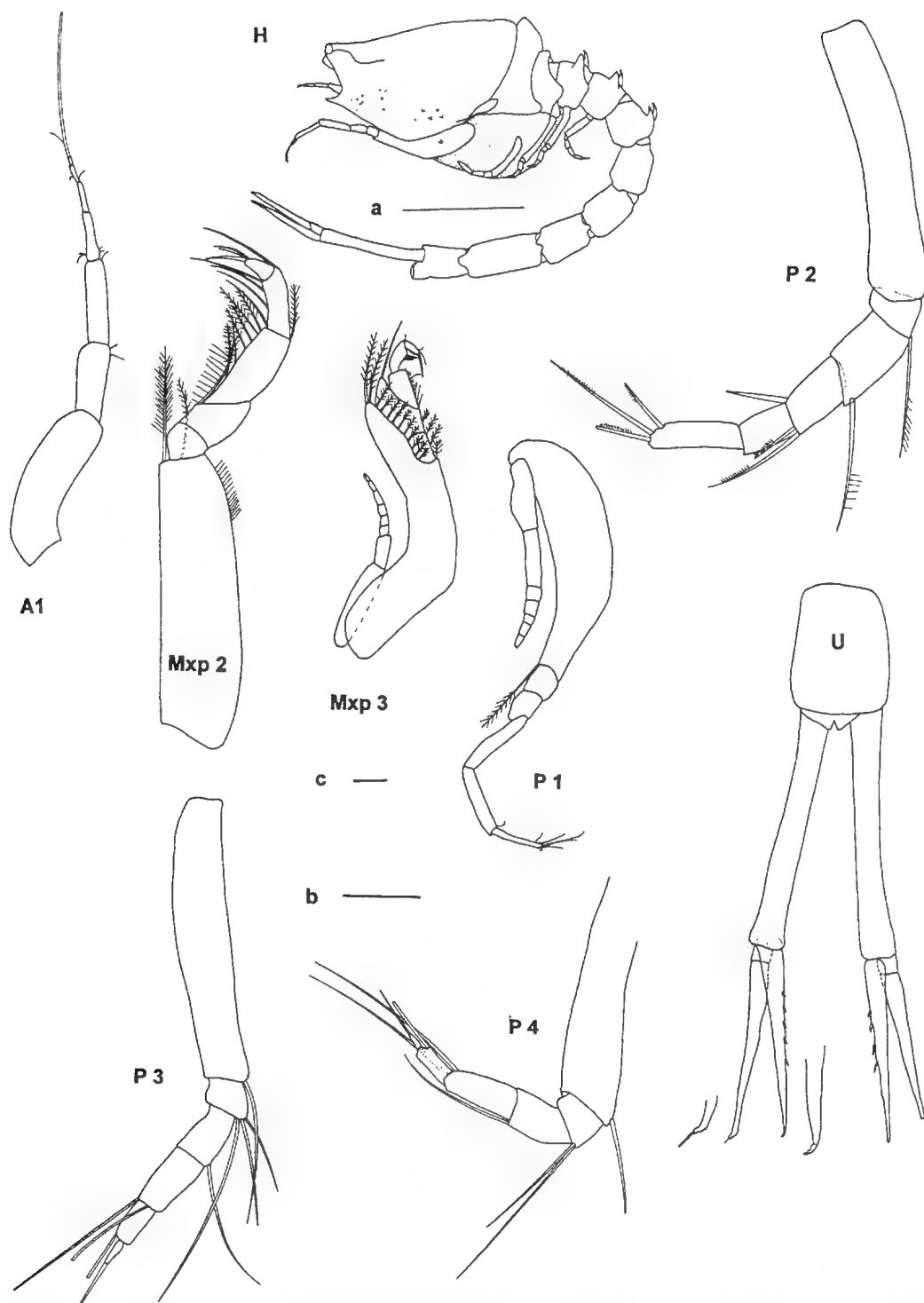


FIGURE 4: *Cyclaspis caprella*, ovigerous female: H: habitus, A1: antenna 1, Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1 to P4: pereopod 1 to 4, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (A1, Mxp2, P2, P3, P4), scale c: 0.1 mm (Mxp3, P1, U).

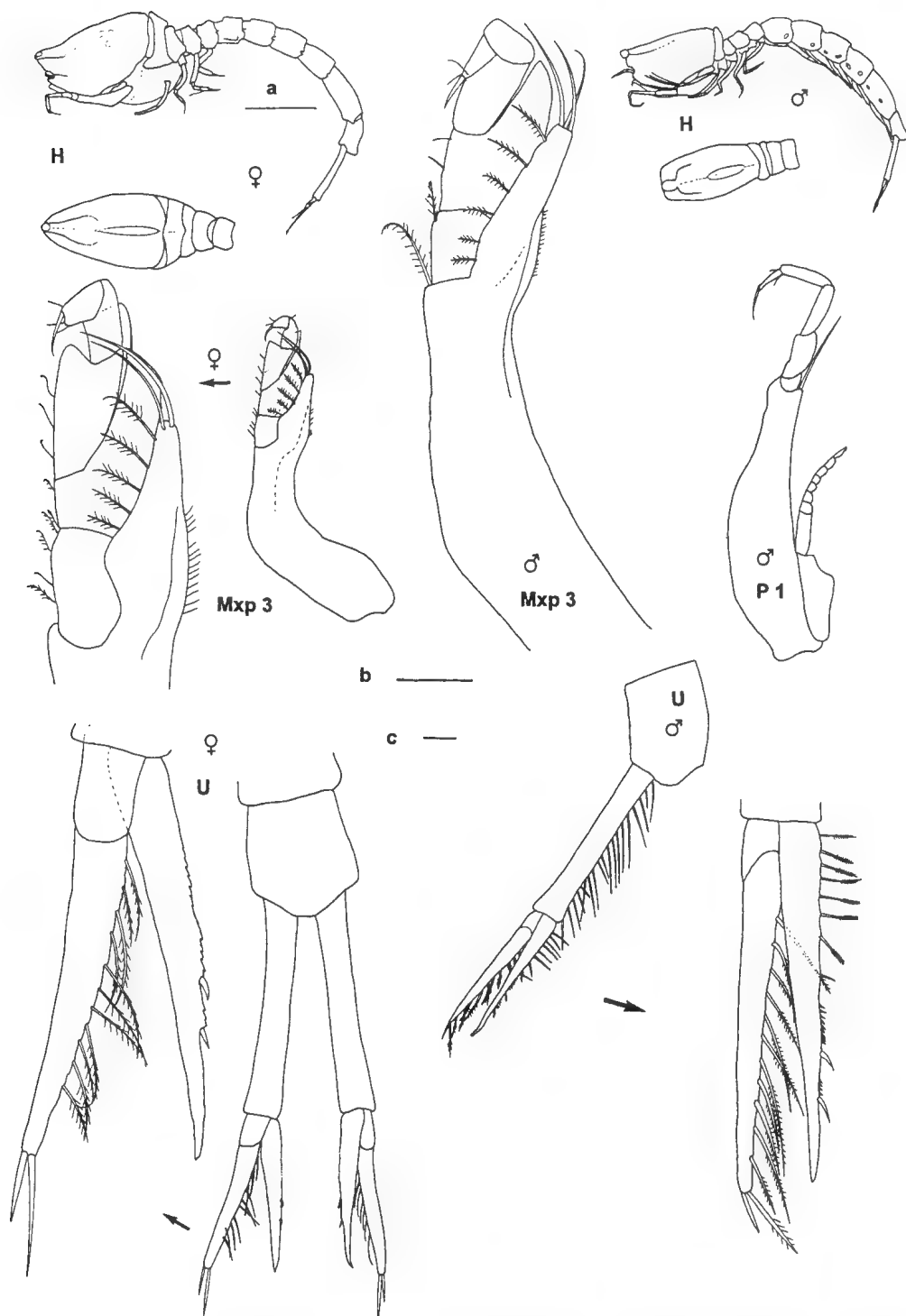


FIGURE 5: *Cyclopsis cottoni*: H: habitus ovigerous female and adult male, Mxp3: maxilliped 3, P1: pereopod 1, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (Mxp3 male, Mxp3 female enlarged, male and female uropods enlarged), scale c: 0.1 mm (female Mxp3, P1, U).

ovigerous and 3 non-ovigerous females, 1 male (broken), 12 juveniles; SA: 129 (Port Augusta): 10 females, 4 males, 2 juveniles; VIC: 148: 1 ovigerous, 6 non-ovigerous and 7 juvenile females; ZMH K 39918.

Remarks

Hale (1937) described an ovigerous female and some years later (Hale, 1944) the male. The most striking characters are impressions at the termination of the anterior, clear-cut part of the dorsal carina and waviness of the double posterior portion of the carapace (Hale 1937; 1944). Hale stated the close position to *C. herdmani* Calman, 1904. It differs from that species in uropods' exopods distally being truncate with two terminal spines rather than acute as in *C. herdmani*.

The specimens from Tasmania (Figure 5) show the female's uropods' endopods proximal part appearing slightly serrated due to the scaly structure, and having two spines in the distal part, the exopod with 11 plumose setae at inner margin.

The male's endopods' proximal part has eight moderate long setae, the distal part being serrated with two distal spines, acute tip, the exopod with at least 11 plumose setae at inner margin, and the peduncle with 10 long plumose setae at proximal part, and 12 serrated setae at distal part.

Distribution

Extended to Tasmania, South Australia and Victoria.

Cyclaspis granulosa Hale, 1944

Material

Whiting Ground, Waterhouse Bay, east end Thistle Island, 4 March 1931, 8.0–8.3 fathoms; 4 males; SAM C 5989.

Remarks

The specimens from the collection of the South Australia Museum fit quite well the following characters given for *C. granulosa*; namely the roughened structure of the carapace, the shape of pereopod 1, and the proportions and armature of the uropods.

Cyclaspis pura Hale, 1936

Material

Whalers Bay, Thistle Is., 3 February 1941, submarine light, leg. K. Sheard, 1 large, non-ovigerous, and 2 subadult females; SAM C 5990.

Remarks

The specimens belong to the 'levis group' and resemble closely the description of *C. pura* given in Hale (1936, 1944) in that the uropod's peduncle is only a little longer than the rami, without long setae, and the exopod has two terminal mucrones; the uropod's endopod is acute and in the present material has three marginal serrated spines distally, proximal part serrated; reticulation of carapace as figured in Hale's description.

Cyclaspis supersculpta Zimmer, 1921 (Figure 1)

Material

WA: 46: 4 subadult females, 6 juvenile females, 2 adult males, 15 juveniles; ZMH K 39919.

Remarks

Tafe & Greenwood (1996) described *C. chaunosculpta* (see below) as being very similar to *C. supersculpta* Zimmer, 1921, only differing in having (*C. supersculpta*) or not having (*C. chaunosculpta*) lateral bulges on either side of the median dorsal ridge of the carapace; *C. chaunosculpta* with more strongly developed transverse ridges than in *C. supersculpta*. Because of their variability, structures of the carapace are not reliable characters to separate species, "...since the ornamentation does not correspond uniformly with any other obvious distinguishing characters" (Day, 1978). Nevertheless, the ornamentation of the carapace is often used to separate species of the genus *Cyclaspis* (Tafe & Greenwood, 1996). To find out whether the two species *C. supersculpta* and *C. chaunosculpta* are synonyms, more detailed analyses, such as molecular studies, are necessary.

The present material resembles closely the figure in Zimmer (1921).

Cyclaspis strumosa Hale, 1948 (Figure 6)

Material

QLD: Lizard Island 1992: Turtle Bay (15 Nov., 15 m): 1 juvenile female, 1 adult male, 1 juvenile; Turtle Bay (12 Nov., 15 m): 1 juvenile female, 1 subadult male; sand (7 m): 1 subadult female, 2 juveniles; sand (10 m): 1 juvenile; Pidgin Point: 1 juvenile female; Mermaid Bay: 1 juvenile; ZMH K 39924.

Remarks

There are only two species described for

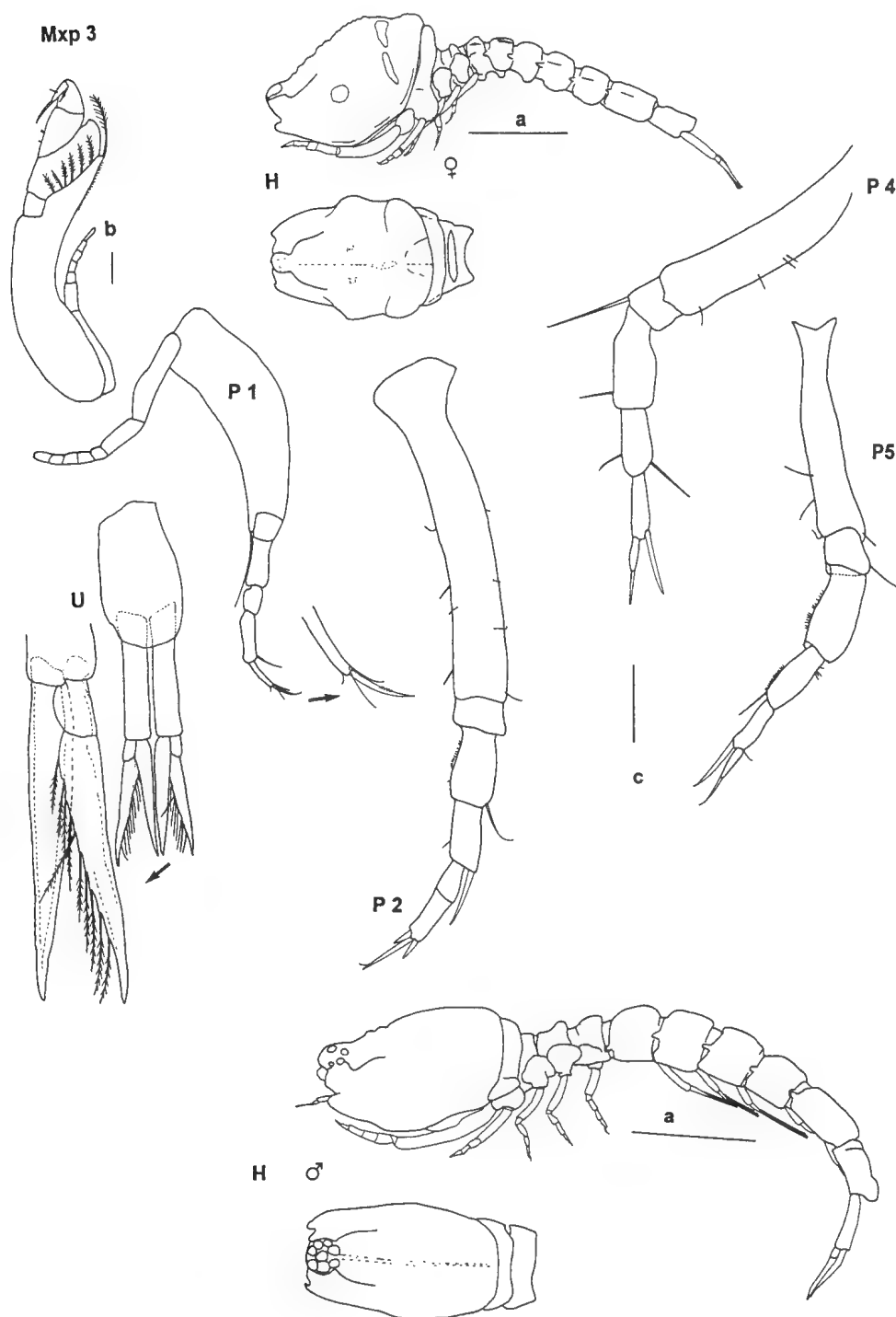


FIGURE 6: *Cyclaspis strumosa*: H: subadult female (above) and male (below) habitus from lateral, and carapace from dorsal; female extremities: Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H, female and male), scale b: 0.1 mm (Mxp 3, P1, U), scale c: 0.1 mm (P2, P4, P5).

Australian waters with an undulated dorsomedian line in the frontal lobes region: *Cyclaspis rudis* Hale, 1948 and *C. strumosa* Hale, 1948. Neither species is included in the determination key presented by Tafe and Greenwood (1996). *C. rudis* is among others characterised by a scaly structure of the carapace's integument. The specimens from Lizard Island resemble in most respects *C. strumosa*. The juvenile female's outline (total length 2.7 mm) from dorsal view with a swollen posterior part of the carapace given in Hale (1948) is different from the outline of the non-ovigerous female (total length 4.75 mm) from Lizard Island. The female's extremities are figured herein. They resemble – aside of the sexual differences typical for males like stouter basis in first pereopod, and more setae at uropod's peduncle and endopod's inner margin – those of the male given by Hale (1948). The inner and outer margins of pereopods 1 and 2 are not serrated as in Hale's figures.

Cyclaspis cf. strumosa Hale, 1948
(Figure 7)

Material

QLD: Lizard Island 1992: Mermaid Bay (7 m): 2 males; ZMH K 39925.

Description

Based on adult male, 4.3 mm in length.

Carapace 1.3 mm in length; ocular lobe wide, reaching tip of pseudorostral lobes; pseudorostral lobes not meeting in front of ocular lobe; siphonal tube very short; antennal notch narrow, subrostral tooth not acute; mediodorsal line a little undulated; free thoracic segments short, combined 0.7 mm in length, the last two with dorsal hump; abdomen 2 mm in length, longer than carapace and free thoracic segments combined; pleonite 6's proportion length to width 1.7.

First antenna basal article a little geniculated, longer than following two articles combined; accessory flagellum missing, main flagellum two-segmented, its basal article more than twice as long as distal, two terminal aesthetascs; second antenna reaching end of body; mandible with four teeth at pars incisiva, 12 long and strong setae between pars incisiva and pars molaris.

Maxilliped 3 basis longer than rest of extremity, distal prolongation over articulation merus to carpus, ischium longer than body of merus, merus with wide and long distal prolongation reaching articulation carpus to propodus, carpus distally widened, as wide as length of propodus, dactylus

short with stout terminal seta, exopod present; pereopod 1 basis longer than rest of extremity, propodus second longest article, exopod present (not figured); pereopod 2 basis subequal to rest of extremity, merus subequal in length to carpus, carpus with three outer distal serrated setae, propodus shorter than dactylus, the latter with two short and one distal setae, which is longer than dactylus; pereopods 3 to 5 similar in shape, basis shorter than rest of extremities, merus to propodus subequal in length, dactylus short, distal seta at propodus at least equal in length to dactylus and its terminal seta combined; uropod's peduncle equal in length to pleonite 6, a little longer than unsegmented endopod (length proportion 1.1), 13 plumose setae at inner margin of peduncle and endopod as well, both rami with acute tip, no terminal seta.

Female unknown.

Remarks

The specimens from Lizard Island resemble the species described by Hale (1948), but differ from the described adult male in basis, merus and carpus of pereopod 1 and 2, and uropods' endopods having no serration.

Cyclaspis cf. agrenosculpta Tafe & Greenwood, 1996
(Figure 8)

Material

QLD: Lizard Island 1992: Turtle Bay (15 m, sand): 1 subadult and 1 juvenile female; Watson's Bay (17 m): 1 female with developed oostegites; ZMH K 39921.

Remarks

Female (subadult, total length 7.62 mm) from Watson's Bay, with right uropod's endopod's subacute tip a little damaged, inner margin serrated with nine hyaline 'teeth'; exopod with 11 plumose setae, subacute tip, rami equal in length, longer than peduncle, length proportion peduncle to rami 0.78, length proportion peduncle to pleonite 6 is 0.81; these specimens from Lizard Island differ from those described by Tafe & Greenwood (1996) in having uropod's rami equal in length instead of exopod longer, and peduncle shorter instead of longer than rami and pleonite 6, respectively, in Moreton Bay specimens. Habitus, shape of first and second pereopods, sculpturing of carapace and structure of integument are the same in Lizard Island and Moreton Bay females, so they seem to be conspecific. Additional figures

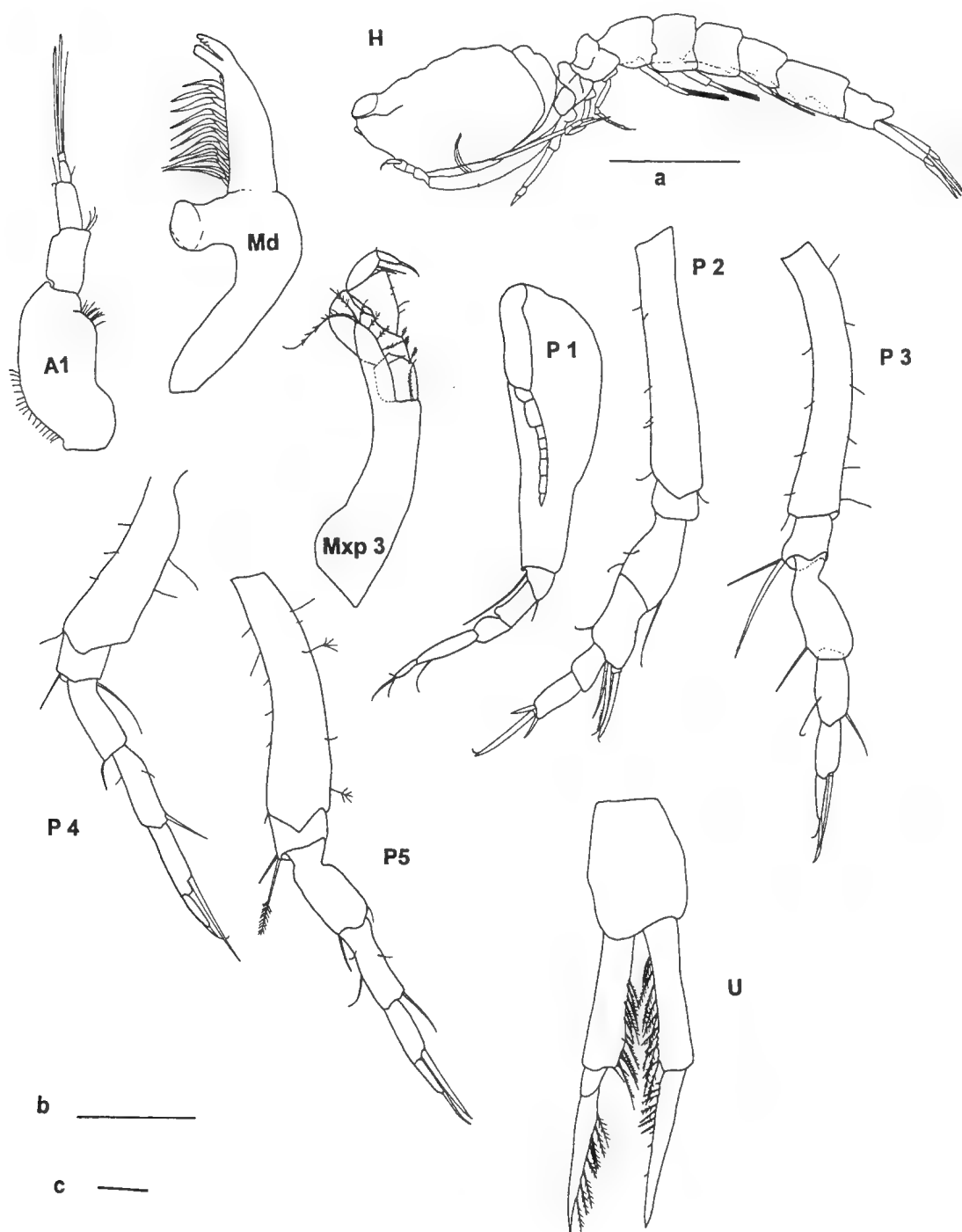


FIGURE 7: *Cyclaspis* cf. *strumosa* male: H: habitus, Md: mandible, A1: first antenna, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods, left exopod and right endopod figured. Scale a: 1 mm (H), scale b: 0.1 mm (A1, Md, P2, P3, P4, P5), scale c: 0.1 mm (Mxp 3, P1, U).

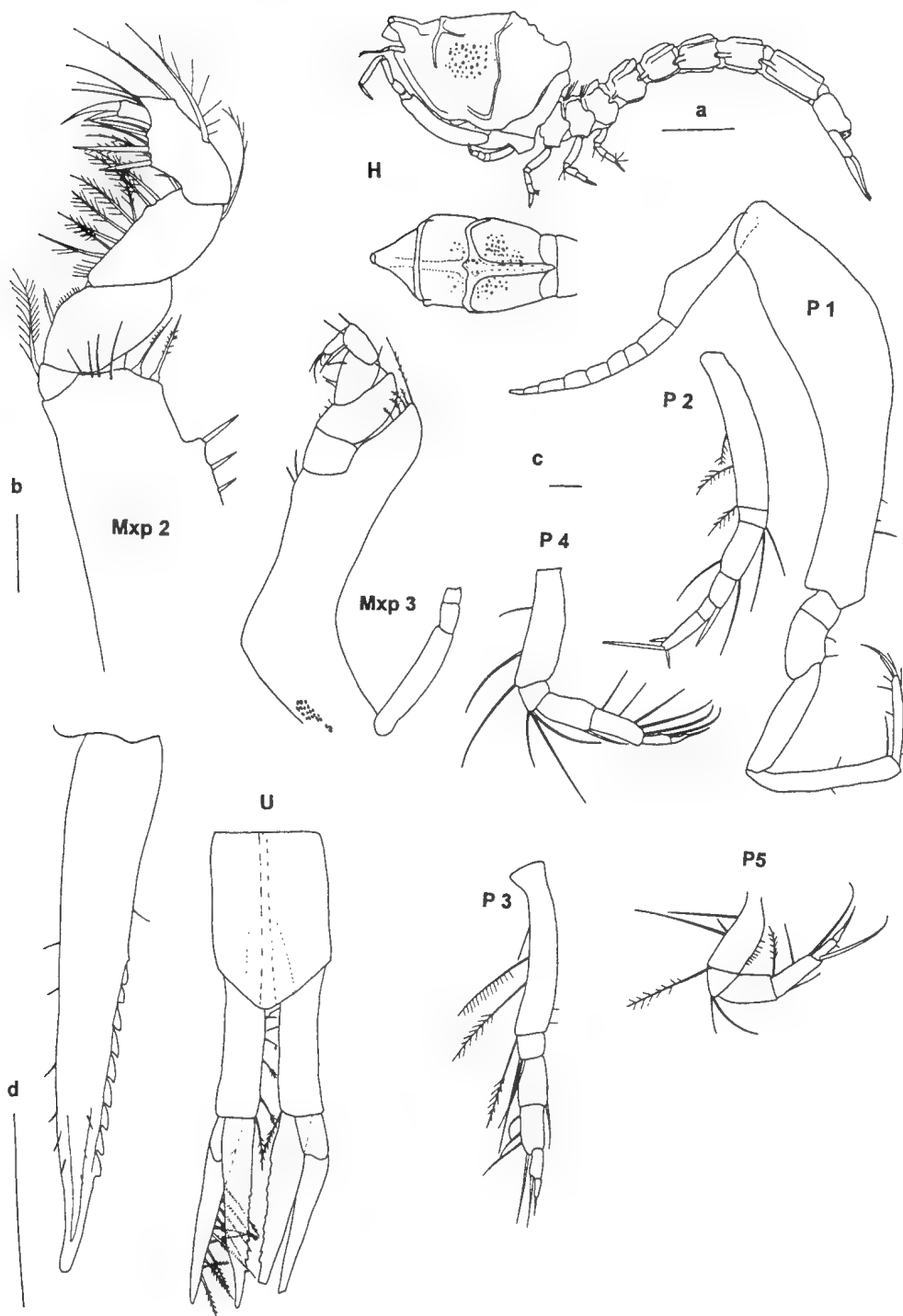


FIGURE 8: *Cyclaspis* cf. *agrenosculpta* subadult female: H: habitus, Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (Mxp2), scale c: 0.1 mm (Mxp 3, P1, P2, P3, P4, P5, U), scale d: 0.1 mm (uropod's endopod enlarged).

of maxilliped 2 and 3, and pereopods 1 to 5 are given herein (Fig. 8).

Cyclaspis lissa sp.n.
(Figures 9 and 10)

Material

1 juvenile male, 12 juveniles; WA-27: 1 subadult female, 1 subadult male, 4 juveniles; WA-28: 2 juvenile specimens; WA-39: 2 subadult males, 1 subadult female, 2 juveniles; WA-66: holotype: 1 ovigerous female, paratypes: 1 ovigerous female, 2 males, additional specimens: 5 ovigerous and 20 subadult females, 2 adult and 6 subadult males, 24 juveniles; WA-67+68: 1 subadult female; ZMH K 39926. WA-10: 4 ovigerous females, 3 subadult and 5 juvenile females; SAM C 6078.

Holotype: female ZMH K 39927, K 39928: extremities of paratypes female and male

Leg.: G. Hartmann & G. Hartmann-Schröder

Date: 21 October 1975

Locus typicus: Western Australia, Drummonds, close to Geraldton, fine sand

Paratypes: 1 female used for dissection, 1 male, 1 male used for dissection.

Diagnosis

Cyclaspis with no ridges, pits or tubercles on the carapace in female, in male no distinct humps near the dorsal end of carapace, no granular structure on the carapace; very short pseudorostral lobes hardly meeting in a point in front of the ocular lobe; basis of pereopod 1 without distal tooth and longer than the rest of extremities; uropod's peduncle longer than pleonite 6, and longer than exopod; uropod's exopod slightly longer than endopod; uropods' rami ending with acute tips, no terminal setae or mucrones.

Description

Based on holotype, ovigerous female, total length 3.4 mm.

Carapace smooth, dorsomedian carina present, not pronounced; pseudorostrum very short, meeting in a point in front of ocular lobe; siphonal tube short; antennal notch very small, small subrostral tooth acute; integument calcified; ocular lobe present. Four thoracic segments visible from above, first segment visible in ovigerous female only from lateral, free thoracic segments nearly half as long as carapace; abdomen as long as carapace and thoracic segments combined; pleonite 6 is 1.4 times longer than wide, shorter than uropod's peduncle.

Description of extremities based on paratype, ovigerous female.

Maxilliped 2 basis longer than rest of extremity; merus, carpus and propodus of similar length, dactylus shorter, with stout terminal seta; maxilliped 3 with exopod, geniculated basis longest article, with distal process reaching joint merus to carpus, ischium short, merus with distal process reaching joint carpus to propodus, carpus widened, propodus stout, shorter than carpus, with two terminal setae, dactylus short and stout with stout terminal seta, two subterminal setae.

Pereopod 1 basis slender, longer than rest of extremity, merus a little longer than ischium, carpus and propodus subequal in length, both a little longer than merus, dactylus slender with one terminal and two subterminal slender setae, exopod present; pereopod 2 basis shorter than rest of extremity, ischium short, merus second longest article, dactylus subequal in length to merus, with one terminal and two subterminal setae; pereopod 3 basis about as long as rest of extremity, ischium a little shorter than merus, both articles combined a little shorter than carpus, propodus as long as merus, dactylus slender, similar to terminal seta of propodus; pereopod 4 basis shorter than rest of extremity, carpus second longest article, dactylus half as long as terminal seta, both combined as long as terminal seta of propodus; pereopod 5 carpus second longest article after basis, dactylus as long as terminal seta of propodus. Uropod's peduncle without spines at inner margin, longer than exopod, unsegmented endopod shorter than exopod; both rami with acute terminal ending; endopod with 6 serrated spines, exopod with 6 setae at inner margin.

Male: Pseudorostral lobes hardly meeting in a point in front of ocular lobe. Male has developed pleopods of same length as holotype; carapace shorter than in female, abdomen longer than carapace and free thoracic segments combined, four pedigerous thoracic segments visible.

Male's extremities differ from female's — extremities are longer and basis of pereopod 1 stouter. Uropod's peduncle 1.7 times longer than pleonite 6, inner margin with 18 plumose setae, exopod longer than endopod, the latter with 11 short and proximally with two long setae.

Etymology

The new species is named after the smooth structure of the carapace.

Remarks

Many species of the genus *Cyclaspis* have no

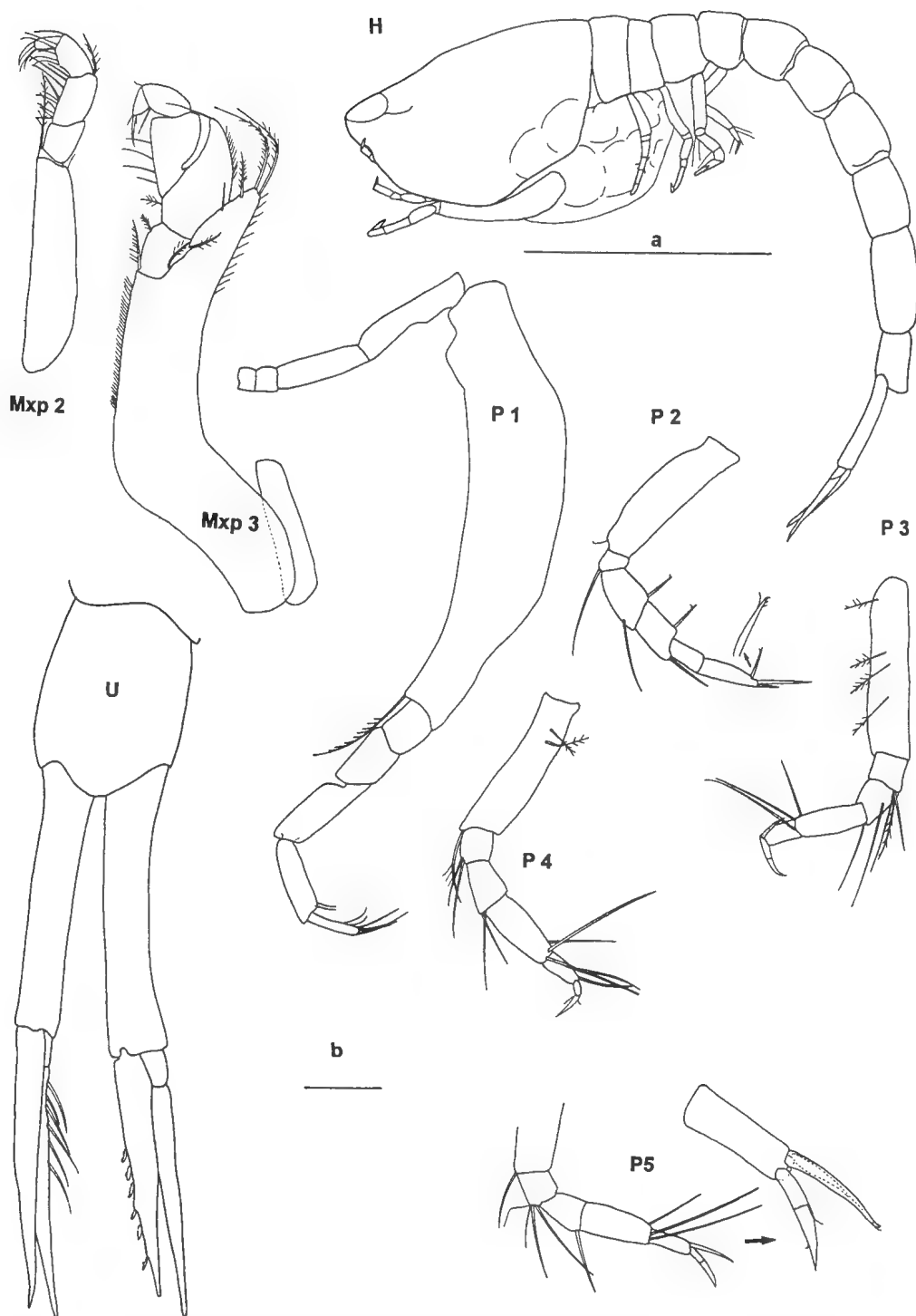


FIGURE 9: *Cyclaspis lissa* sp.n. ovigerous female: Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (Mxp2, Mxp3, P1, P2, P3, P4, P5, U).

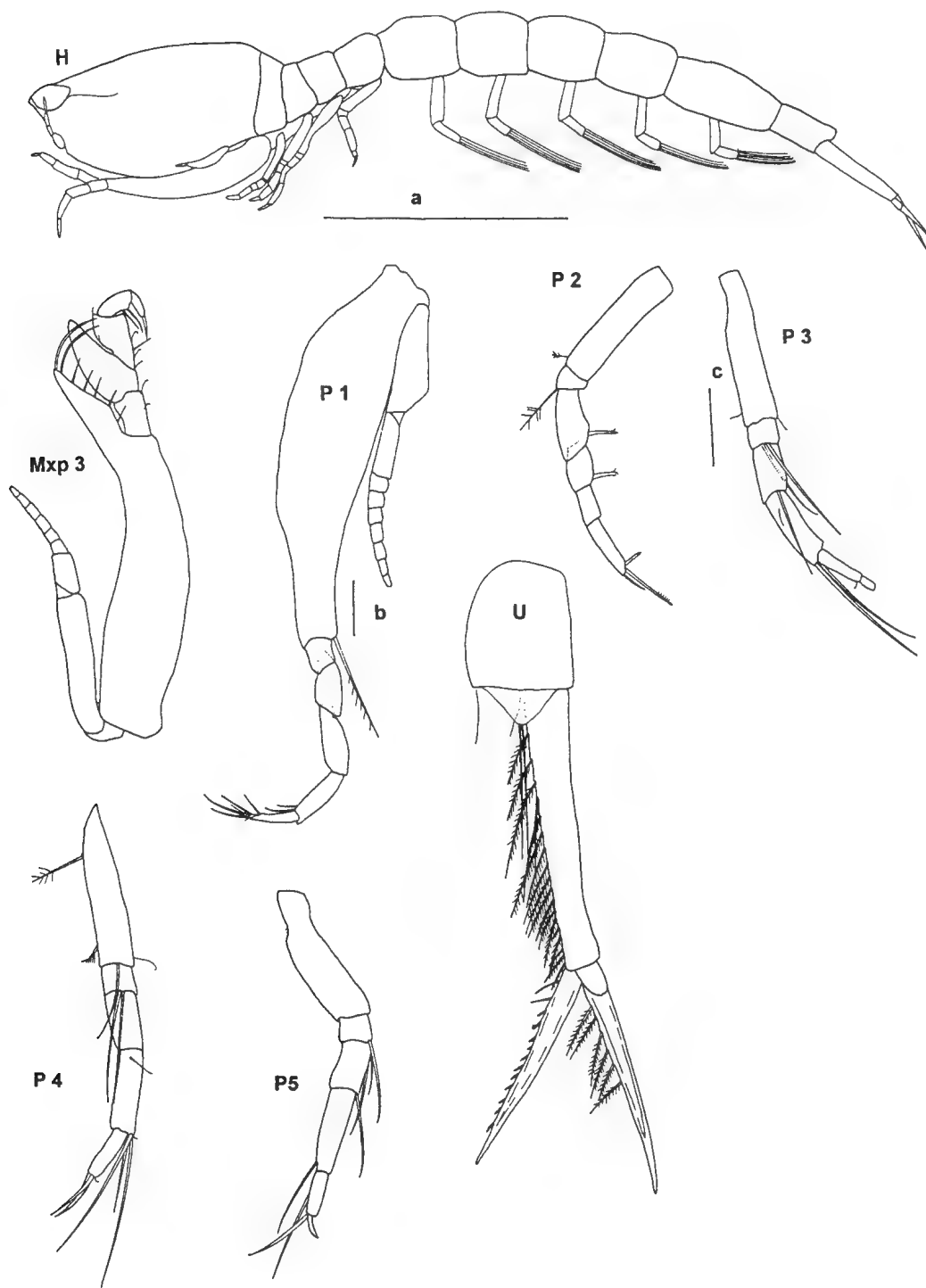


FIGURE 10: *Cyclaspis lissa* sp.n. adult male: H: habitus, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods (the two long 'setae' between the uropods peduncles belong to the antenna's flagella). Scale a: 1 mm (H), scale b: 0.1 mm (Mxp3, P1, U), scale c: 0.1 mm (P2, P3, P4, P5).

ridges, pits or tubercles on the carapace, Hale (1944) erected a key to these species in his section 1. In this section he separated the 'picta group' with eyes developed and the pseudorostral lobes meeting for an appreciable distance in front of the ocular lobe, and the 'levis group' with pseudorostral lobes barely or not meeting in front of the ocular lobe. Tafe & Greenwood (1996) followed him in their emended key. Thirty-five *Cyclaspis* species with a smooth carapace are currently known. Only two species out of these have the following character combination as in the species described above:

- 1) uropods' rami ending with acute tips, no setae or mucrones
- 2) very short pseudorostrum or pseudorostral lobes hardly meeting in front of ocular lobe
- 3) uropod's peduncle longer than pleonite 6
- 4) uropod's peduncle longer than exopod
- 5) uropod's exopod longer than endopod
- 6) basis of pereopod 1 without distal tooth and longer than the rest of extremities.

The combination of these characters is given in *Cyclaspis sheardi* Hale, 1944. The new species is close to *C. sheardi* because of the terminal seta of pereopod 2 being longer than dactylus in both species. It differs from *C. sheardi* in not having distinct humps near the dorsal end of carapace in males, and in the absence of a granular structure on the carapace. The pseudorostral lobes in males in *C. sheardi* are very short but clearly meet in front of carapace, whereas they hardly do in *C. lissa* sp.n.

Cyclaspis ursulae sp.n.

(Figures 11 and 12)

Material

WA: 23: 2 subadult females, 1 adult and 1 subadult male, 8 juveniles; WA-30: 28 juveniles; WA-37: 1 ovigerous and 1 subadult female, 1 adult and 7 subadult males, 17 juveniles; ZMH K 39923. WA- 4+15: 2 subadult females, 1 subadult male, 4 juveniles; SAM C 6079.

Habitus: ovigerous female holotype, subadult and adult male

Extremities: WA-23 adult male total length 5.4 mm, pleon damaged; WA-14+15 female with developing oostegites, only carapace to first pleonite, carapace length 1.6 mm.

Holotype: ovigerous female ZMH K 39922a, ZMH K 39922b: extremities of paratypes

Leg.: G. Hartmann & G. Hartmann-Schröder

Date: 2 October 1975

Locus typicus: 7 km east of Dampier, Horsines Cove

Diagnosis

Cyclaspis with quadrilateral area on each side of the carapace defined by ridges, the anterior transversal ridge not crossing the frontal lobe of the carapace of the female, pitted carapace structure in female, unsegmented uropod's endopod acute, uropod's exopod with two distal spines.

Description

Based on the holotype, 5.6 mm length in total.

Carapace seen from lateral with two transverse ridges, the anterior not crossing the frontal lobe, but turning backwards to meet the two 'horns' reaching forwards, formed by posterior ridge; seen from dorsal transverse ridges do not cross dorsomedian ridge but run parallel to it in posterior part; pseudorostral lobes do not meet in front of elongated ocular lobe; siphonal tube short; dorsomedian line a little pronounced; antennal notch small, anterolateral margin smooth, anteroventral margin of carapace smooth, integument reticulate, well calcified; eyes present; four free thoracic segments visible, the first of them (second pedigerous segment) with dorsal prolongation, carapace and free thoracic segments combined 2.81 mm in length.

Abdomen about same length as carapace and free thoracic segments combined, with lateral articular processes and dorsally a faint ridge reaching the fifth pleonite; pleonite 6 shorter than peduncle of uropod, length proportion of peduncle to pleonite 6 is 1.38.

Description of extremities based on paratype (WA-14+15) subadult female, carapace and free thoracic segments combined 2.53 mm in length, abdomen missing.

First antenna basis only a little geniculated, longer than two following articles, outer margin hairy, distal article second longest; main flagellum two-segmented with four aesthetascs and two short setae, accessory flagellum short, less than half as long as main flagellum's basal article, with two short setae. Maxilliped 2 basis longer than rest of extremity, distal inner part with one strong spine, merus distal inner part with one long plumose seta reaching distal end of carpus; this article second longest, at inner margin four strong plumose setae; propodus with four pairs of plumose (only one row figured) setae at inner margin, dactylus short with strong terminal spine; maxilliped 3 basis a little geniculated, distal outer

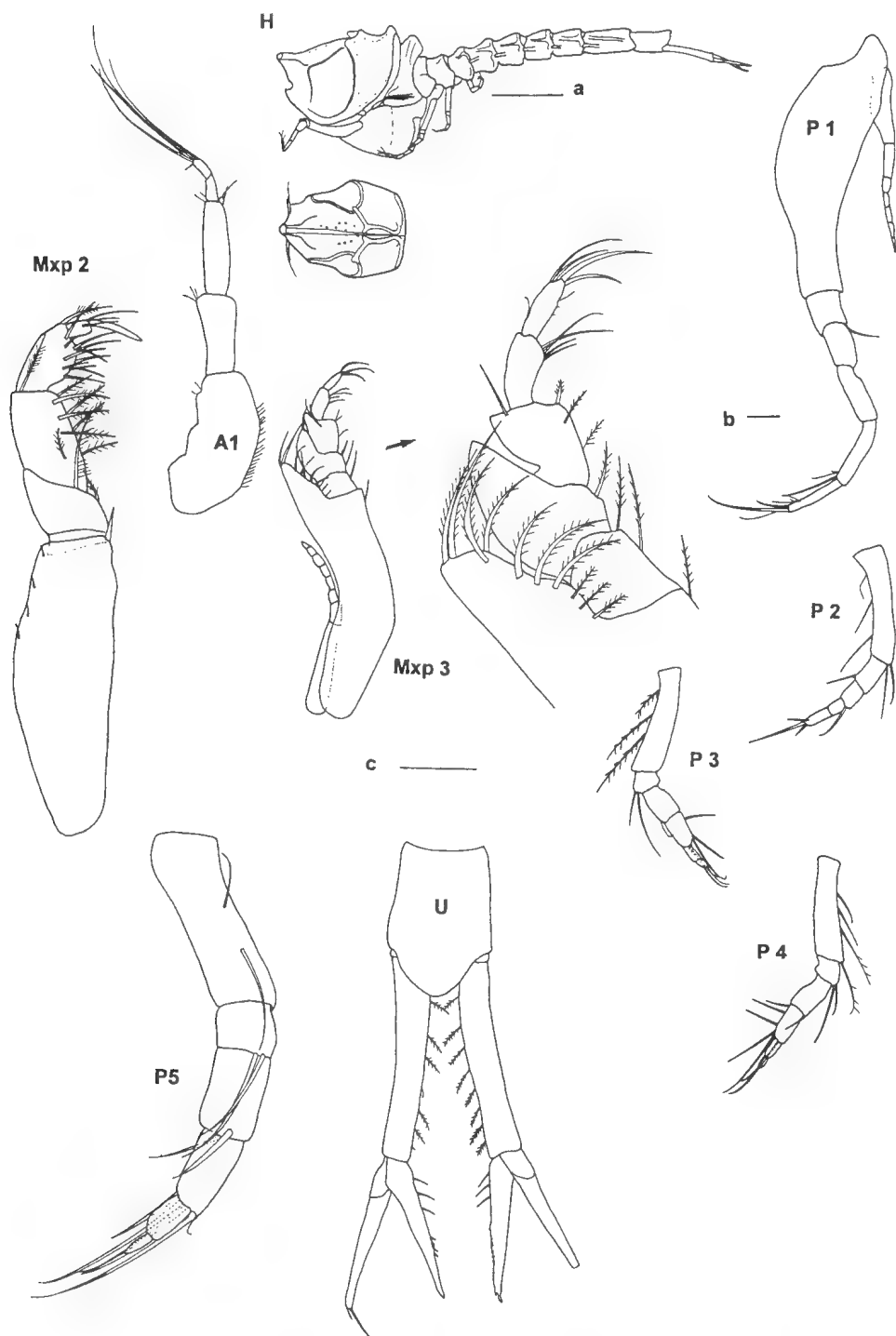


FIGURE 11: *Cyclaspis ursulae* sp.n. ovigerous female: H: habitus, subadult female A1: antenna 1, Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (Mxp3, P1, P2, P3, P4, U), scale c: 0.1 mm (A1, Mxp 2, Mxp 3 distal part, P5).

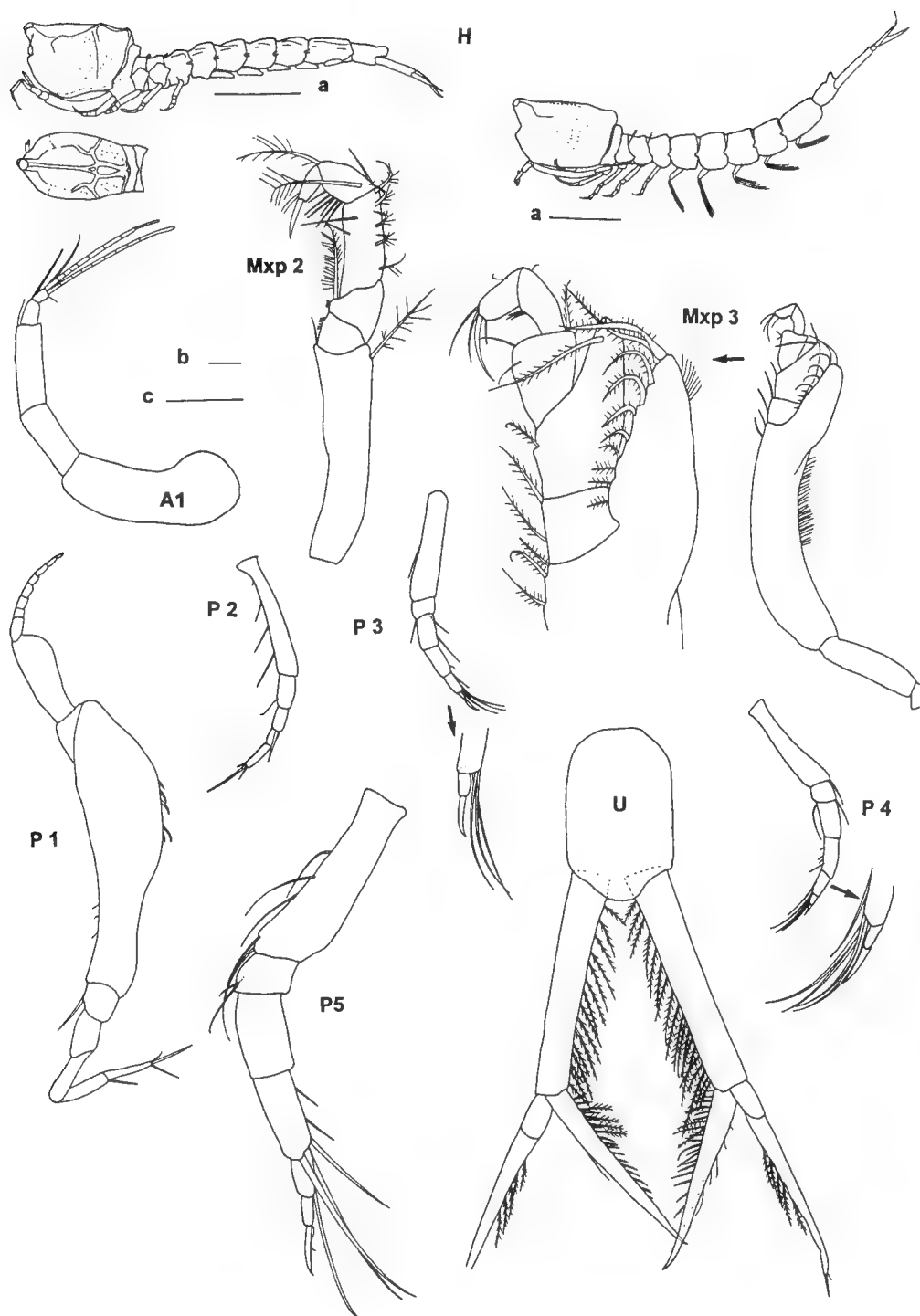


FIGURE 12: *Cyclaspis ursulae* sp.n. male: H: habitus subadult (left) and adult (right) male, subadult male A1: antenna 1, Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (Mxp3, P1, P2, P3, P4, U), scale c: 0.1 mm (A1, Mxp 2, Mxp 3 distal part, P5).

prolongation reaching distal third of merus, prolongation with ten plumose setae; merus outer distal prolongation reaching articulation carpus to propodus; carpus second longest article with strong simple spine at outer and plumose seta at inner distal margin, propodus a little longer than dactylus, dactylus with four terminal spines, one of them strong; exopod present.

Pereiopod 1 basis subequal in length to distal articles combined, ischium equal in length to merus, propodus second longest article, slender dactylus a little shorter than carpus, with three terminal setae, one of them stronger; exopod present. Pereiopod 2 basis longer than rest of extremity, ischium missing, merus second longest article, carpus with one strong distal seta, dactylus longer than carpus, with one strong terminal seta more than twice as long as dactylus, and two subterminal setae.

Pereiopod 3 basis shorter than rest of extremity, ischium with two distal setae, one of them reaching beyond articulation carpus to propodus, merus and carpus equal in length, carpus with two distal setae, two of them reaching to tip of dactylus' strong terminal seta. Pereiopod 4 similar to pereiopod 3. Pereiopod 5 basis shorter than rest of extremity, ischium with two long distal setae, merus with one strong distal spine, carpus with three distal setae, two of them reaching further than dactylus' strong terminal seta.

Uropod's peduncle longer than pleonite 6, and 1.4 times longer than endopod, inner margin with seven or eight simple setae, endopod with three setae at proximal part of inner margin, distal part serrated and with five or seven spines, tip subacute; exopod longer than endopod, inner margin appearing serrated due to scaly structure, one long and one shorter terminal seta.

Adult (5.1 mm in length) and subadult (4.6 mm in length) males (WA-37).

Carapace smooth in adult, sculptured in female as in subadult male, pleonite 6 shorter than uropod's peduncle.

Description of extremities based on male paratype (WA-23). First antenna as in female but first article of peduncle longer and more slender, accessory flagellum minute with three aesthetascs.

Maxilliped 2 as in female, basis with one, propodus with additional two strong plumose setae, carpus with plumose setae at outer margin; maxilliped 3 as in female; pereiopod 1 as in female, basis with 5 spines; pereiopod 2 as in female, basis longer and more slender; pereiopods 3 to 5 as in female; uropods, aside from sexual

differences (numerous setae at inner margins of peduncle and rami), as in female.

Etymology

The species is named in memory of Ursula Heuer, the co-collector of the material from Indonesia.

Remarks

The new species and the three species mentioned before belong to the *exsculpta*-group of section 2 (Hale, 1944; Tafe & Greenwood, 1996). This group contains 18 species with a quadrilateral area on each side of the carapace defined by ridges or tubercles, distinct and depressed in females, often indistinct in males (Tafe & Greenwood, 1996). This group can be extended by two species, *C. strumosa* and *C. rudis*. From these species only males or young females are known; the females might show the typical transverse folds while the males have carapace structures like males of other species of the *exsculpta*-group. Within the *exsculpta*-group there is a species subgroup with very similar characters: *C. chaunosculpta* Tafe & Greenwood, 1996, *C. persculpta* Calman, 1905, *C. supersculpta* Zimmer, 1921, *C. tribulis* Hale, 1928, *C. exsculpta* Sars, 1887, *C. usitata* Hale, 1932, and *C. alveosculpta* Tafe & Greenwood, 1996.

A comparison of characters of selected species within the *exsculpta*-group is given in Table 2, not including species with big lateral horns as in *C. aspera* Hale, 1944 and *C. bovis* Hale, 1928, and species with aberrant ridges at carapace like *C. australis* Sars, 1887, *C. indoaustralica* Bacescu, 1992 and *C. similis* Calman, 1907.

The new species resembles *C. ornosculpta* Tafe & Greenwood, 1996 from Moreton Bay, Queensland. The main character differing between the two species is the anterior transverse ridge not crossing the frontal lobe of the carapace of the female in *C. ursulae* sp.n.

Genus *Mossambicuma* Day, 1978

Mossambicuma victoriae sp.n.

(Figures 13 and 14)

Material

VIC: 165: 2 females, 2 males, 1 exuvia; ZMH K 39934. 1 male; SAM C 6080.

Holotype: ovigerous female; ZMH K 39932, ZMH K 39933: extremities of paratypes

TABLE 2: Character comparison of the *exsculpta*-group of the genus *Cyclaspis*. C: carpus, M: merus.

<i>Exsculpta</i> -group	<i>C.</i> <i>agrenosculpta</i>	<i>C.</i> <i>alveosculpta</i>	<i>C.</i> <i>candida</i>	<i>C.</i> <i>chaunosculpta</i>	<i>C.</i> <i>ursulae</i> n.sp female and subad. male	<i>C.</i> <i>ursulae</i> n.sp adult male
uropod's endopod	bluntly pointed	acute	acute	acute	acute	acute
uropod's exopod	acute	acute or tiny mucro	acute	acute	spine	2 spines
longest ramus	exopod	equal	exopod	equal	exopod	exopod
Length proportion						
peduncle:pleonite 6, male	1.3	0.9	1.2	0.8	1.3	1.4
peduncle:pleonite 6, female	1.0	0.7	—	—	1.4	—
peduncle:endopod, male	1.1	0.8	about 1	0.8	1.2	1.2
peduncle:endopod, female	1.1	0.7	—	—	1.4	—
setae at endopod, male	11 short, 21 long plumose	13 spines, 27 long	plumose setae	9 spines, 12 plumose	4 long, 15 short	4 long, 17 serrated
setae at endopod, female	1 stout, 7 short	11 short	—	—	3 long, 7 spines	—
pereiopod 1	C longer M	C longer M	—	C longer M	C longer M	C longer M
no. of spines at basis, male	18	27	0?	21	—	5
long setae at pereionites	3 to 5	no	3 to 5	3 and 4	3 and 4	3 to 5
structure of carapace	reticulate	reticulate	?	pitted, sponge like	pitted	reticulate
Carapace ridges						
transverse in female	2	2	—	2, first not pronounced	2, not meeting on frontal lobe	2 lateral, 1 from dorsal
transverse in male	2	—	2?	—	—	no
longitudinal	—	humps in female	—	one hump in both sexes	—	1 pair
dorsomedian carina	present	present	—	present	present	present

<i>Exsculpta</i> -group	<i>C. supersculpta</i> WA 46	<i>C.</i> <i>supersculpta</i>	<i>C.</i> <i>exsculpta</i>	<i>C.</i> <i>mawsonae</i>	<i>C.</i> <i>tribulis</i>	<i>C.</i> <i>usitata</i>
uropod's endopod	acute	acute	acute	acute	acute	acute
uropod's exopod	acute	acute	mucro	acute	acute	acute
longest ramus	subequal	equal	equal	exopod	equal	equal
Length proportion						
peduncle:pleonite 6, male	1	—	0.6	1.2	—	—
peduncle:pleonite 6, female	0.8	0.4	—	—	1	0.8
peduncle:endopod, male	0.9	—	0.6	1.1	—	—
peduncle:endopod, female	0.8	0.6	—	—	1	0.9
setae at endopod, male	7 spines, 7 teeth, 28 plumose	—	4 short, 13 long	7 short, 22 long plumose	—	—
setae at endopod, female	5–6 hairy setae	serrated margin	—	—	14 short spines?	7 short spines
pereiopod 1	C longer M	C equal to M	C longer M	C longer M	C longer M	C longer M
no. of spines at basis, male	15	?	0	0	0	0
long setae at pereionites	3 and 4	3 and 4	3 and 4	3.00	no	no
structure of carapace	—	reticulate	reticulate	reticulate	reticulate	reticulate
Carapace ridges						
transverse in female	—	2	—	—	2	2
transverse in male	—	—	2	1?	—	—
longitudinal	—	—	2 pairs	1 pair	1 pair	—
dorsomedian carina	—	present	present	present	present	present

TABLE 2: (continued)

<i>Exsculpta</i> -group	<i>C. elegans</i>	<i>C. ornosculpta</i>	<i>C. prolifica</i>	<i>C. persculpta</i>	<i>C. rudis</i>	<i>C. strumosa</i>
uropod's endopod	acute	acute	acute	acute	acute	acute
uropod's exopod	spine	with spine	?	acute	acute	acute
longest ramus	subequal	exopod	exopod?	equal	equal	endopod
Length proportion						
peduncle:pleonite 6, male	1.0	1.1	—	—	1	1.1
peduncle:pleonite 6, female	0.8	1.1	—	0.8	—	—
peduncle:endopod, male	1.1	1.3	—	—	0.67	0.9
peduncle:endopod, female	0.9	1.4	1.0	0.8	—	—
setae at endopod, male	18 plumose	7 spines, 12 plumose	?	—	4 setae, 12 long setae	2 stout, 10 slender, serrated
setae at endopod, female	serrated, 5 plumose setae	2 plumose, serrated margin	4 short, serrated	3 spines, serrated	—	—
pereiopod 1	C longer M	C longer M	C longer M	?	C longer M	C shorter M
no. of spines at basis, male	0	0	?	?	0	0
long setae at pereionites	no	no	no	3 and 4	2	no
structure of carapace	?	reticulate	reticulate	pitted	scaly	pitted
Carapace ridges						
transverse in female	2	2	2	2	—	—
transverse in male	2	—	?	—	no	slightly 2 pairs
longitudinal	2 pairs	1 lateral pair	—	2 pairs	1 pair	no
dorsomedian carina	present	present, pronounced	pronounced	present	present	present
Remarks	—	—	—	2 horns at middle	—	—

Leg.: G. Hartmann & G. Hartmann-Schröder

Date: 18. January 1976

Locus typicus: Australia, Victoria, southern head end of Clarence River, near Yamba, brackish water and mangroves

Paratypes: female and male for dissection of extremities.

Diagnosis

Mossambicum with long siphonal tubes separated but close together; no abrupt border between carapace and second pereionite in female; uropods' peduncles shorter than pleonite 6 and rami; third maxilliped basis and merus with long distal prolongations; basis of pereiopod 1 geniculated; pereiopod 2 distal seta longer than dactylus.

Compared to the other species of this genus, in *M. elongatum* the basis of third maxilliped is shorter and more geniculated, both basis and merus of third maxilliped having a longer distal prolongation in the new species.

Description

Based on the holotype, an ovigerous female, length 2.7 mm.

Carapace compressed, longer than free thoracic segments, first segment fused, lateral ridge running from below frontal lobe dorsoposterior to dorsomedian line; pseudorostrum long, siphonal tubes long, separated but close together. Dorsomedian line pronounced in anterior half, less pronounced in posterior part where lateral ridge runs parallel to dorsomedian line, very last part of carapace without ridge or pronounced dorsomedian line; antennal notch shallow; anterolateral margin smooth; anteroventral margin of carapace smooth; integument weakly pitted; eyes present.

Four thoracic segments visible; abdomen 1.1 times longer than carapace and thoracic segments combined; pleonite 6 is 1.5 times longer than uropods' peduncles and 1.4 times longer than wide.

Description of extremities, based on paratype, ovigerous female, length 3 mm. First antenna long, mid article 1.1 times longer than basal one, both combined 1.1 times longer than distal one; main flagellum two-segmented, terminal with one aesthetasc and one short, two long setae, accessory flagellum reduced, replaced by one seta; maxilliped 3 basis geniculated, with long and

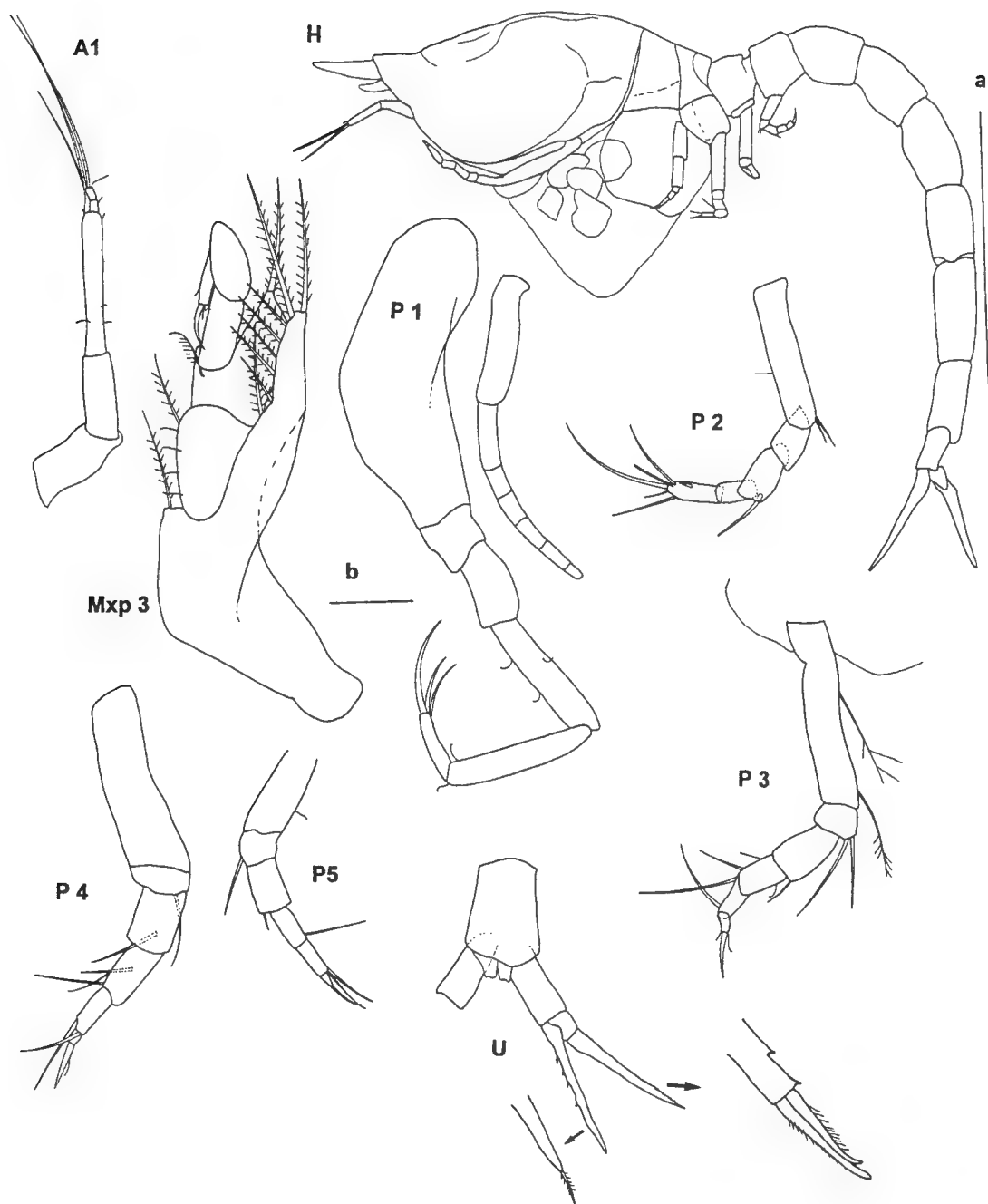


FIGURE 13: *Mossambicum victoriae* sp.n. ovigerous female: H: habitus, A1: first antenna, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (A1, Mxp3, P1, P2, P3, P4, P5, U).

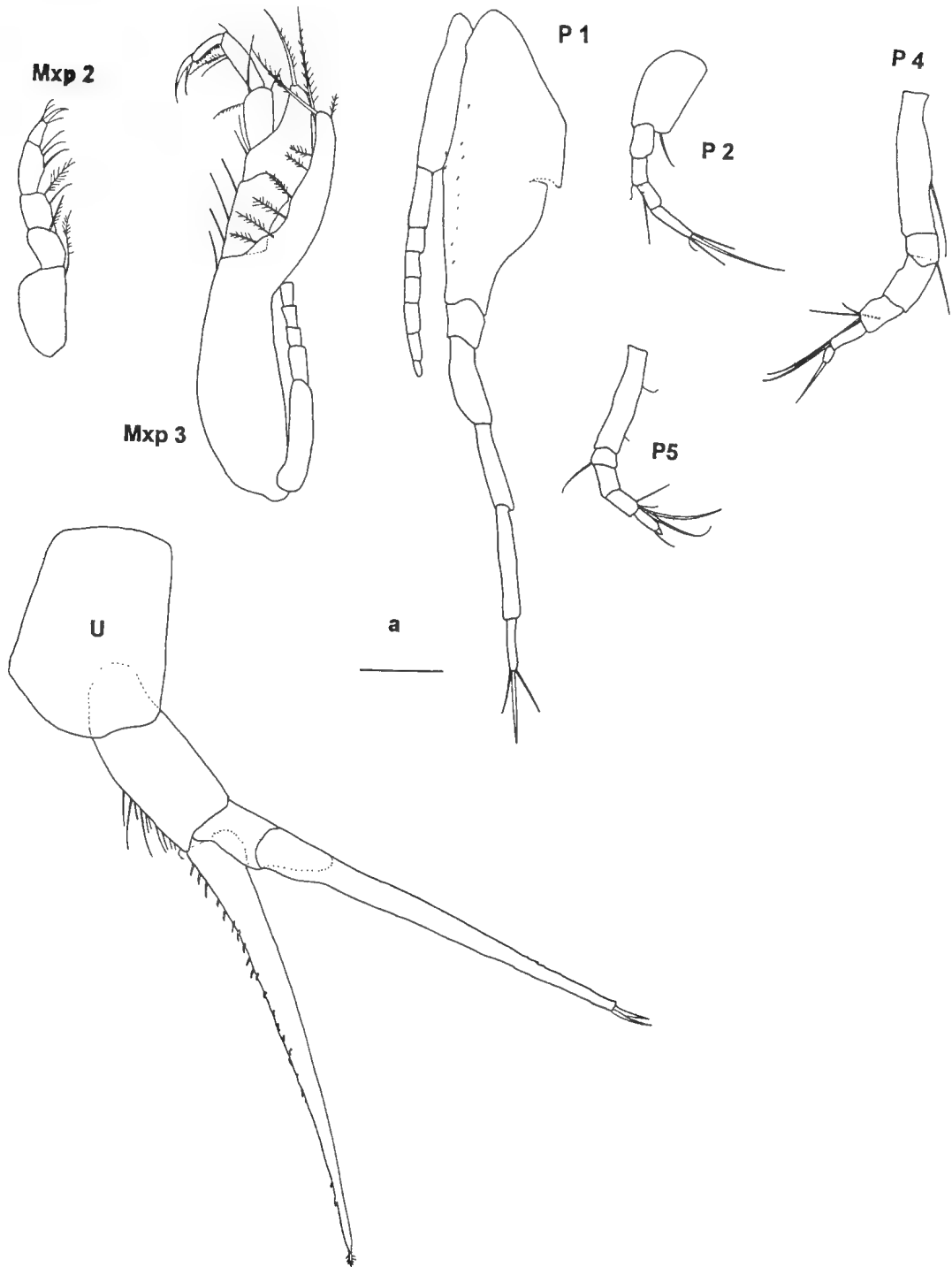


FIGURE 14: *Mossambicum victoriae* sp.n. male: Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 0.1 mm (Mxp2, Mxp3, P1, P2, P4, P5, U).

wide outer distal prolongation carrying eight plumose setae at inner margin, the two distal ones very long, prolongation almost reaching articulation carpus to propodus; ischium longer than merus, the latter with long and wide outer distal prolongation reaching articulation carpus to propodus, propodus egg shaped, dactylus slender with terminal claw-like seta, exopod present (not figured); pereopod 1 basis shorter than rest of extremity, slightly geniculated, ischium shorter than merus, both articles combined shorter than carpus, propodus second longest article, dactylus with three terminal setae, exopod present; pereopod 2 basis shorter than rest of extremity, ischium missing, merus equal in length to dactylus, longer than propodus but shorter than carpus, terminal seta longer than dactylus; pereopod 3 basis equal in length to rest of extremity, distal seta of carpus reaching tip of terminal seta which is longer than dactylus; pereopod 4 basis equal in length to rest of extremity, distal seta longer than dactylus; pereopod 5 similar in shape to pereopod 4; uropod's peduncle short compared with pleonite 6 and rami, exopod two-segmented, longer than endopod; dorsal ridge with double row of scales, distal tip with two serrated spines; endopod unsegmented with four strong and short spines at inner margin; outer margin scaly, terminal tip with acute plumose seta.

Males dorsomedian line and lateral ridge less pronounced than in female; extremities dissected from male paratype, length 2.5 mm; second antenna reaching articulation of pleomers 3 to 4, pereopod 1 basis more stout but rest of extremity more slender, pereopod 2 shorter than in female, uropods' peduncles with 11 setae at distal part of inner margins, endopod with 20 spines at proximal part, distal part with scales, one terminal plumose seta as in female, exopod with two serrated terminal spines.

Etymology

The new species is named after the type locality.

Remarks

Day (1978) described a new genus, *Mossambicum*, with the striking characters: ischium of maxilliped 3 larger than merus, basis of pereopod 1 without distal projection, second pereopod without ischium, uropods' peduncles shorter than pleonite 6 and rami, pleonite 6 shorter than fifth abdominal somite. She mentioned the resemblance to the genus *Eocuma* Marcusen, 1894

but she also stressed the differences from this genus, such as the form of the carapace and the first pereopod not having the distal projection of basis typical for *Eocuma*. The genus *Mossambicum* seemed to be monotypic, with the type species *M. elongatum* Day, 1978 found only at the type locality, the Morumbene estuary (Mühlenhardt-Siegel, 1996). The Australian new species clearly belongs to this genus. It differs from the known species in the female's habitus as there is no abrupt border between carapace and second pereonite, the siphonal tubes are longer, the basis of third maxilliped is shorter and more geniculated, both basis and merus of the third maxilliped have a longer distal prolongation, the basis of pereopod 1 is geniculated, pereopod 2 has a distal seta that is longer than the dactylus in the new species but shorter in *M. elongatum*.

Subfamily VAUNTHOMPSONIINAE Sars, 1878

Genus *Glyphocuma* Hale, 1944

Glyphocuma oculodentata sp.n.
(Figure 15)

Material

QLD: Lizard Island 1992: Turtle Bay (15 November, 15 m): 3 subadult females; sand (10 m): 1 subadult female, 2 juveniles; Mermaid Bay (7 m): 1 juvenile; Lagoon (7 m): 1 juvenile; ZMH K 39936.

Holotype: adult but non-ovigerous female; SAM C 5997a, SAM C 5997b: extremities of paratype

Leg.: V. Siegel, U. Mühlenhardt-Siegel

Date: 20 November 1992

Locus typicus: Australia, Queensland, Lizard Island, Watson's Bay, 16 m

Paratypes: Watson's Bay (16 m): 2 adult females, 3 juvenile females; SAM C 5998.

Diagnosis

Glyphocuma with six dorsomedian teeth in anterior half of carapace and one strong tooth at anterior end of ocular lobe reaching the tip of pseudorostrum, accessory flagellum of antenna 1 half as long as basal article of main flagellum, uropod's endopod distal article a little longer than basal.

Description

Based on holotype, a subadult female, 7.6 mm in length.

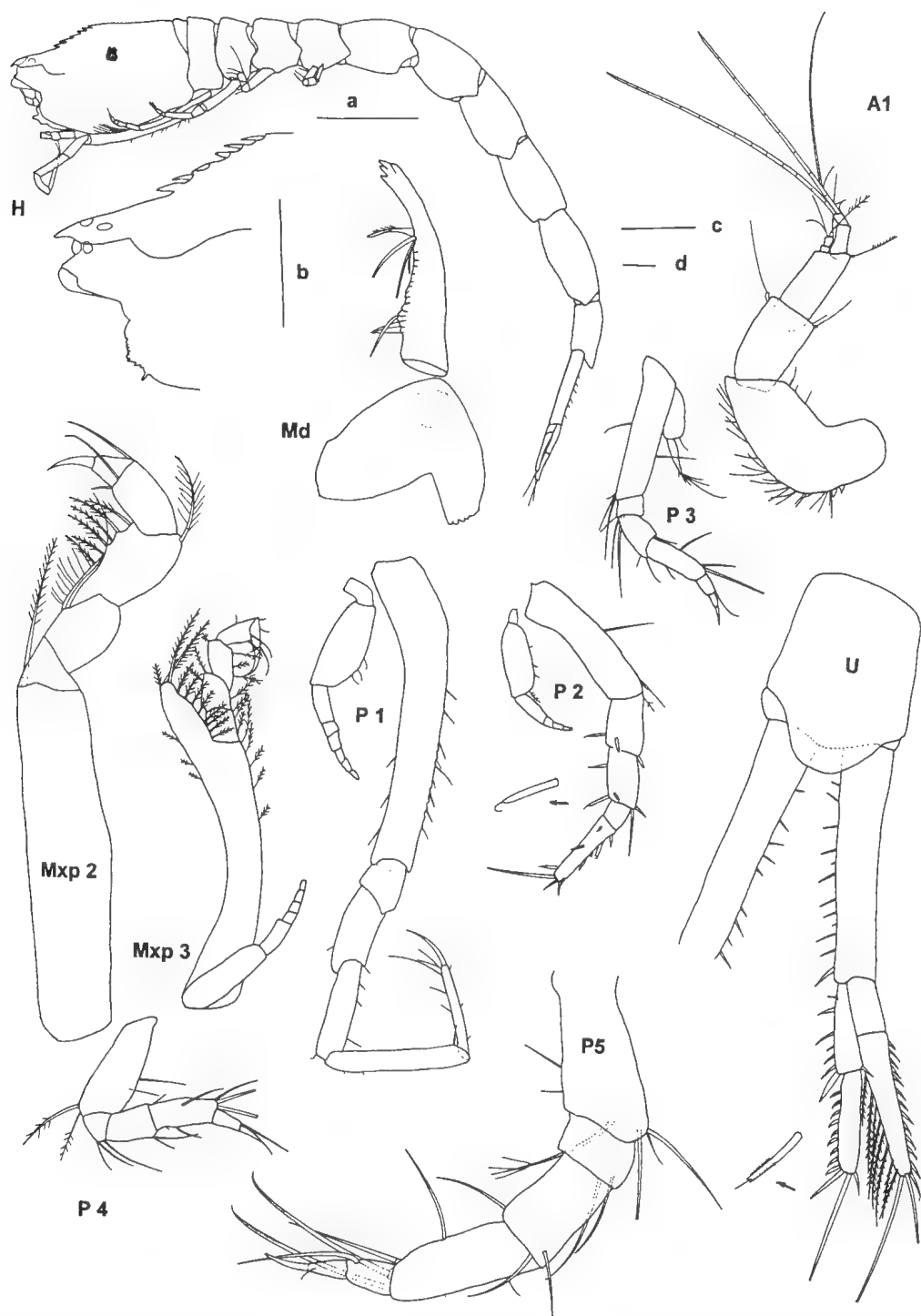


FIGURE 15: *Glyphocuma oculodentata* sp.n. female: H: habitus, A1: first antenna, Md: mandible, Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropod. Scale a: 1 mm (H), scale b: 0.5 mm (anterior part of carapace enlarged), scale c: 0.1 mm (A1, Md, Mxp2, P5), scale d: 0.1 mm (Mxp3, P1, P2, P3, P4, U).

Carapace slender, as long as free thoracic segments, straight to posterior part of frontal lobe, the dentated line ascending, the undentated posterior half straight; pseudorostrum and siphonal tube short; dorsomedian line dentated in anterior half with six teeth; antennal notch reaching the posterior end of ocular lobe; subrostral tooth not pronounced; anterolateral margin serrated; anteroventral margin of carapace smooth; integument with fine reticulate structure as figured in Figure 17; eyes present.

Five free thoracic segments visible from above, the first one short, laterally covered by carapace and second free thoracic segment, third and fourth segments laterally produced backwards; abdomen longer than carapace and thoracic segments combined; pleonite 6 shorter than uropod's peduncle.

The description of the extremities is based on paratype, a female. First antenna basal article geniculated with many hair-like setae, both following articles equal in length, main flagellum two-segmented, distally with two aesthetascs and one annulated long seta, accessory flagellum two-segmented, half as long as basal article of main flagellum, with three terminally plumose setae and one shorter simple seta. Mandible with 17 setae, pars incisiva with four terminal 'teeth', pars molaris short and stout. Maxilliped 2 straight, basis longer than rest of extremity, ischium more than half as long as merus, carpus second longest article with 6 plumose setae at inner margin and one at distal outer margin, dactylus short and stout, ending with stout terminal seta; maxilliped 3 basis long and slender, distal prolongation with 11 plumose setae, two of them being twice as long as the others; ischium a little shorter than merus; carpus and propodus equal in length, dactylus with stout terminal seta, exopod present; pereopod 1 basis shorter than rest of extremity, propodus second longest article after basis, exopod present; pereopod 2 dactylus second longest article after basis, terminal seta shorter than dactylus, ischium not visible, propodus small, exopod present; pereopod 3 carpus second longest article after basis, dactylus short with longer terminal seta, exopod present; pereopod 4 carpus second longest article after basis, terminal seta longer than dactylus; pereopod 5 carpus second longest article after basis, with two long distal setae reaching beyond tip of dactylus' terminal seta; uropod's peduncle longer than rami with 12 setae at inner margin, rami equal in length, exopod with eight plumose setae at inner and 13 stout setae at outer margin of distal article,

endopod two-segmented, basal article a little shorter (factor 0.9) than distal, with seven setae at inner and one at outer distal margin, distal article with ten stout setae, the distal one being longer, one long terminal and one shorter subterminal seta.

Etymology

The new species is named after the tooth on the ocular lobe.

Remarks

The new species resembles *G. dentata* Hale, 1944. In Jones's (1984) species list, *G. cf. dentata* (identified by J. Day) is mentioned for Lizard Island. The specimens in the present collection differ from *G. dentata* by: presence of the large tooth at the distal tip of ocular lobe, which is missing in *G. dentata*; accessory flagellum of antenna 1 half as long as basal article of main flagellum, being shorter in *G. dentata*; uropod's endopod distal article a little longer than basal, but the distal being nearly half as long as basal one in *G. dentata*.

Genus *Leptocuma* Sars, 1873

Leptocuma longidactylum sp.n.

(Figure 16)

Material

North end Herald Bight, Shark Bay, 3 fathoms, sand, 'Isobel' W.H., 21 November 1945, submarine light, temperature: 24.22°C ; 30 males; SAM C 5992.

Holotype: male; SAM C 5991

Locus typicus: Australia, South Australia, north end Herald Bight, Shark Bay, 3 fathoms, sand, 'Isobel' W.H., submarine light, temperature: 24.22°C

Date: 21 November 1945

Diagnosis

Leptocuma with two spines at distal end of first pereopod's basis, ischium of second pereopod longer than carpus. Bases of the pereopods in males more slender and longer, compared to the exopods' bases.

Description

Based on the holotype, adult male, 3.6 mm in length.

Carapace 0.9 mm in length, pseudorostral lobes not meeting in front of ocular lobe, siphonal tube

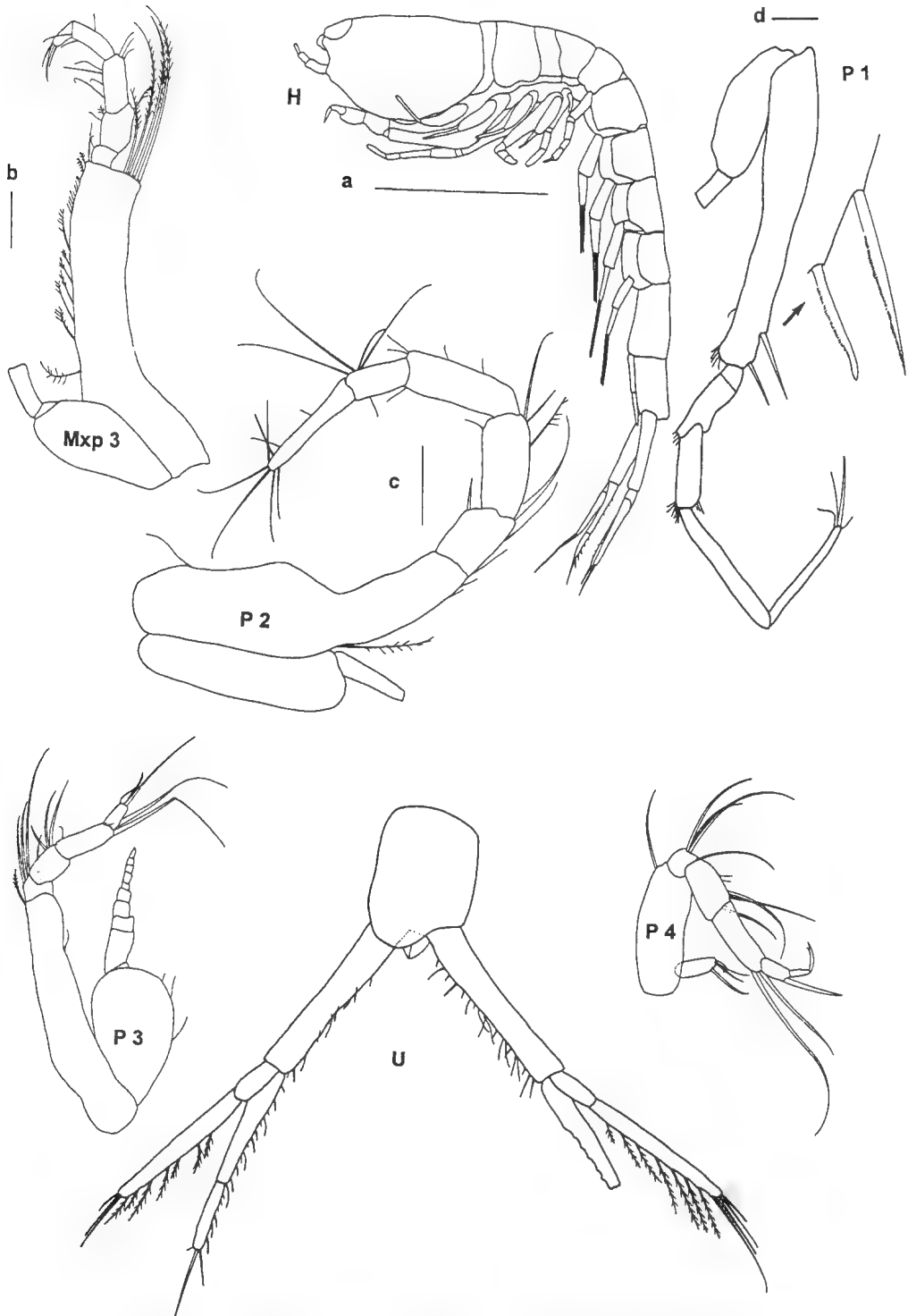


FIGURE 16: *Leptocuma longidactylum* sp.n. adult male: H: habitus, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, U: pleonite 6 and uropods. Scale a: 1 mm (H), scale b: 0.1 mm (Mxp 3, P3, P4), scale c: 0.1 mm (P2), scale d: 0.1 mm (P1, U).

very short, dorsomedian line straight, not pronounced; antennal notch wide and shallow, anterolateral margin rounded, anteroventral margin of carapace smooth; ocular lobe present, no lenses visible; free thoracic segments 0.8 mm in length, second thoracic segment longest; abdomen 1.9 mm in length, longer than carapace and free thoracic segments combined; pleonite 6 shorter than uropod's peduncle.

The description of the extremities is based on the paratype, adult male. Maxilliped 3 basis much longer than rest of extremity, wider than following articles, with four long, plumose setae, inner margin with short plumose setae and hair-like setae; merus a little wider than ischium and carpus, subequal in length to carpus and propodus, exopod present; pereopod 1 basis longest article but shorter than rest of extremity, at distal inner margin a serrated seta preceded by a longer serrated seta, outer distal edge with hair-like setae; propodus second longest article, exopod present; pereopod 2 basis longest article but shorter than rest of extremity, proximal part wider than distal, ischium longer than propodus, dactylus second longest article, tapering, exopod present; pereopod 3 basis longer than rest of extremity, ischium with three long and one shorter distally annulated setae, merus with three annulated setae in distal part; carpus distally with two long simple setae, propodus and dactylus short, exopod present; pereopod 4 basis longest article but shorter than rest of extremity, distally each article with long simple setae: basis one, ischium three, merus three, carpus two, propodus one stout, dactylus one terminal stout, exopod rudimentary; uropod's peduncle longer than pleonite 6 but shorter than rami, 9 to 19 setae at inner margin; exopod equal in length to endopod, inner margin with seven plumose setae, three terminal long simple setae; endopod two-segmented, proximal article 1.8 times longer than distal, proximal article with 13, distal article with six setae at inner margin, two long terminal and one short hair-like setae at outer distal edge.

Etymology

The new species is named after the long dactylus of the second pereopod.

Remarks

Nine Australian *Leptocuma* species are described for the genus. According to Tafe & Greenwood (1996) they are divided into two groups:

- Group 1 with smooth strong setae at distomedial margin of first pereopod's basis, propodus with well developed brush of setae at distal end, uropod's endopod proximal article shorter or only a little longer than distal. Only two of the Australian *Leptocuma* species are in this group: *L. pulleini* Hale, 1928 and *L. vicarium* Hale, 1944.
- Group 2 with serrated seta at distal end of first pereopod's basis preceded by another serrated seta, distal end of propodus with few setae, uropod's endopod with distal article longer than proximal. The new species belongs to the second group. For South Australia only two *Leptocuma* species are described: *L. pulleini* Hale, 1928, belonging to group 1, and *L. sheardi*, Hale 1936, belonging to group 2.

The new species differs from *L. sheardi* in having the bases of the pereopods in males more slender, and longer compared to the exopods' bases; the distal articles of the new species' pereopods bear fewer long setae than those of *L. sheardi*. The most striking characters of the new species are the dactylus being longer than the carpus and the long ischium, both of the second pereopod, which are unique within the genus.

Leptocuma sp.

(Figure 17)

Material

WA: 46, 1 ovigerous female; ZMH K 39935.

Description

Based on the strongly decalcified female, total length 3.3 mm.

Carapace shorter than five free thoracic segments, pseudorostral lobes not meeting in front of rounded ocular lobe; abdomen subequal in length to carapace and free thoracic segments combined; pleonite 6 a little (1.2 times) longer than wide, two anal valves visible, length proportion of uropod's peduncle to pleonite 6 is 1.5.

Maxilliped 3 basis longer than rest of extremity, slightly geniculated, distal half of inner margin with 14 plumose setae, distal outer margin sloping backwards, with five long plumose setae, exopod present; pereopod 1 basis longest article, 0.77 as long as rest of extremity, inner margin with seven plumose setae, distal end of inner margin with two stout serrated spines, outer distal end with one short plumose seta, propodus second longest article, 1.1 times longer than slender dactylus,

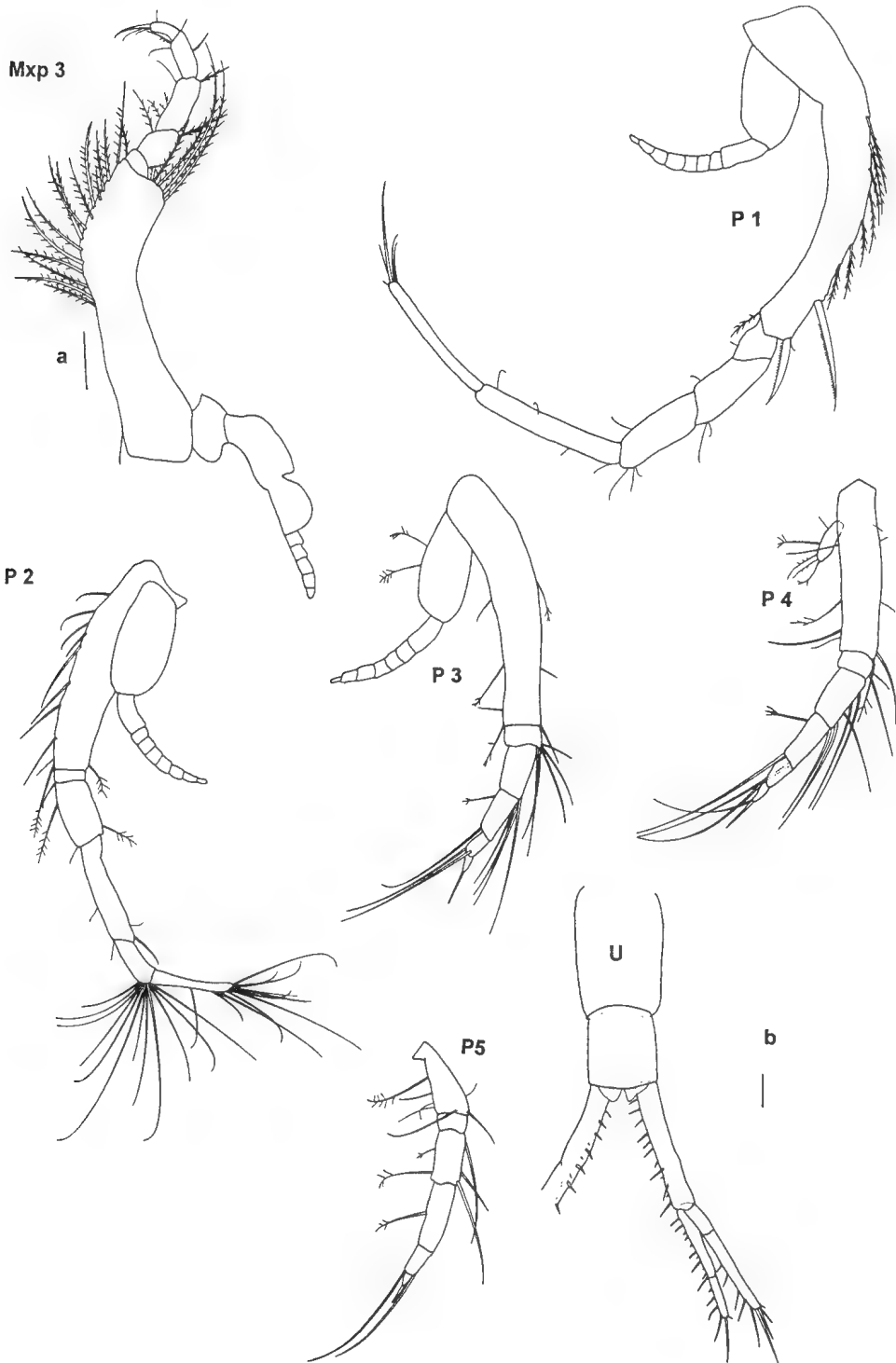


FIGURE 17: *Leptocuma* sp. female: Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 0.1 mm (Mxp3, P1, P2, P3, P4, P5), scale b: 0.1 mm (U).

TABLE 3: Comparison of *Leptocuma* species with two serrated spines at distal end of first pereopod's basis in either sex.

Character	<i>L.</i> <i>barbarae</i>	<i>L.</i> <i>intermedium</i>	<i>L.</i> <i>kennedyi</i>	<i>L.</i> <i>obstipum</i>	<i>L.</i> <i>serriferum</i>	<i>L.</i> <i>sheardi</i>	<i>L.</i> sp.	<i>L.</i> <i>longidactylum</i> sp.n.
Length-proportions								
P1, propodus:dactylus	1.2	1.1	1.3	1.1	1.3	1.2	1.1	1.2
uropod's peduncle: endopod	0.9	?	0.9	1	0.9	1.1	1.1	0.9
uropod's endopod basal:distal	1.5	2.6	1.7	2.3f	1.6	2.0	1.2	1.8
longest ramus	exo		equal	equal	equal	equal		equal
P2, propodus:dactylus	0.6	1.3	0.5	0.8	0.6	0.8	0.7	0.6
Number of setae at uropod								
peduncle	18m, 11f	?	5-6m	23m, 16f	15f	17m, 14f	12f	19m
endopod proximal article	16m, 11f	16m	10-11m	16m, 17f	18f	14m, 9f	12f	13m
endopod distal article	8m, 9f	8m	4-5m	8m, 8f	11f	8m, 5f	6f	9m
Maxilliped 3, setae at basis								
inner margin	?	?		last 3/4	long at prox., short at distal		14 at distal half	10
distal outer margin	?	?		8	6		5	4

m: male; f: female

exopod present; pereopod 2 basis as long as merus, carpus and propodus combined, carpus second longest article, about twice as long as propodus, propodus with 12 hair-like setae at distal end, 0.68 times as long as tapering dactylus, dactylus with 11 terminal and subterminal hair-like setae, exopod present; pereopod 3 basis longer than rest of extremity, carpus a little shorter than merus, which is second longest article, propodus and dactylus short, ischium, merus, carpus, and propodus distally with long terminal annulated setae, dactylus with one strong terminal seta, exopod present; pereopod 4 similar to pereopod 3, but basis shorter than rest of extremity, exopod rudimentary; pereopod 5 basis much shorter than rest of extremity, carpus second longest article, fewer setae than preceding extremities, propodus with two long terminal setae. Uropod's peduncle with 12 unequal spiny setae at inner margin, 1.1 times longer than endopod; uropods' rami: exopod with five setae at inner, three at outer margin, and one seta each terminally and subterminally, a little longer than endopod; endopod two-segmented, basal article 1.2 times longer than distal, basal article with 11, distal article with four unequal setae at inner margin, one longer terminal seta.

Remarks

Five species of the genus *Leptocuma* are described with two serrated spines located distally at the basis of first pereopod: *L. obstipum* Hale, 1944, *L. intermedium* Hale, 1944 both from New

South Wales; *L. serriferum* Hale, 1944 from West Australia and New South Wales; *L. barbarae* Tafe & Greenwood, 1996 and *L. kennedyi* Tafe & Greenwood, 1996 both from Queensland. In *L. sheardi* Hale, 1944 described from South Australia, only males have two serrated spines at the basis of first pereopod, females have one. The female of the Western Australian material is compared with the other species mentioned (Table 3). It does not fit with any of the described species, so it is probably new. It is not named because of the poor condition of the single specimen.

Genus *Picrocuma* Hale, 1936

Picrocuma poecilotum Hale, 1936

Material

Various stations, Noosa R., 40 mesh tow net, June 1940, leg. ISR Munro; 6 ovigerous females, SAM C 5993.

Remarks

The specimens from the collection of the South Australian Museum fit the most striking characters of *P. poecilotum* given in Hale (1936). These are the large second pereionite, the pseudorostral lobes meeting in front of ocular lobe, a dorsal hump seen in lateral view behind the ocular lobe in males and juveniles, and more posterior in ovigerous females. A comparison of the characters within the genus is given in Table 4.

TABLE 4: Comparison of *Picrocuma* species. l: length, w: width.

	<i>Picrocuma poecilotum</i>	<i>Picrocuma crudgingtoni</i>	<i>Picrocuma rectangularis</i> n.sp.
Carapace			
male l:w	1.8	1.7	1.7
female l:w	1.5	?	1.6
Dorsal humps	behind ocular lobe	pereionite 2	no
Uropods' endopods' setae			
male	12 + 1 long	6 + 1 long	8 + 1 long
female		3	4 + 1 long
Uropods' proportions			
peduncle l:w, male	3?	2?	4.5
peduncle l:w, female			3.5
endopod l:w, male	3.4	3.9	5.8
endopod l:w, female			3.1
peduncle:pleonite 6, male	1.5	1.4	1.8
peduncle:pleonite 6, female		1.3	1.5
endopod:peduncle, male	1.1	0.9	0.7

l: length; w: width

Picrocuma rectangularis sp.n.
(Figure 18)

Material

WA: 17+18: 7 males, 10 females;

Holotype: non-ovigerous female; ZMH K 39938.

Leg.: G. Hartmann & G. Hartmann-Schröder

Date: 20 September 1975

Locus typicus: Derby, silty lower eulitoral zone

Paratypes: WA-28, Port Hedland, 27 September 1975, fine sand on reef top, 2 males, 3 females, ZMH K 39939; 1 male, 2 females; SAM C 6081.

Diagnosis

Minute species of *Picrocuma*, uropod's peduncle slender, long compared to the other known species, uropods' rami with a rectangular shape.

Description

Based on holotype, female 1.4 mm in length.

Carapace smooth, shorter than free thoracic segments, proportion length to width 1.6; pseudorostrum as long as ocular lobe, siphonal tube not visible; dorsomedian line not pronounced; antennal notch not present; anterolateral margin smooth; anteroventral margin of carapace rounded. Integument, although decalcified due to fixation in formalin, with a reticulate pattern visible in higher magnification; eye not pigmented.

Five free thoracic segments visible, the first slender, second long; abdomen shorter than carapace and free thoracic segments combined; pleonite 6 shorter than wide (0.9), shorter than uropods' peduncles, length proportion peduncle to pleonite 6 is 1.5.

Description of extremities based on paratype. First antenna basal article geniculated, distal article longest, accessory flagellum minute, main flagellum short, two-segmented, three distal setae.

Maxilliped 3 basis slightly geniculated, shorter than rest of extremity, carpus second longest article, dactylus with strong terminal and three hair-like subterminal setae, exopod present; pereopod 1 basis shorter than rest of extremity, carpus second longest article, similar in shape to maxilliped 3, exopod present; pereopod 2 basis shorter than rest of extremity, ischium missing, dactylus second longest article after basis; merus, carpus, and propodus decreasing in length, exopod present; pereopod 3 with exopod, similar to pereopods 4 and 5, basis shorter than rest of extremities, carpus second longest article;

uropod's peduncle longer than rectangular rami, inner margin without armature, exopod longer than unsegmented endopod, exopod with one long and one short terminal spine, endopod with three spines at inner margin, one terminal spine 0.6 times as long as endopod.

Male 1 mm in length, similar to female, except for following characters: antenna 1 basal article not geniculated, basis of maxilliped 3 more slender, exopods' basal article more rounded than in female in all extremities, uropods' peduncles longer than in female, length proportion peduncle to pleonite 6 is 1.8, rami equal in length, endopod with eight spines at inner margin and one terminal longer one.

Etymology

The new species is named after the rectangular shape of its uropods' rami.

Remarks

Only two species are currently known in the genus *Picrocuma*: *P. poecilotum* Hale, 1936 from Queensland, Tasmania and South Australia and *P. crudgingtoni* Tafe & Greenwood, 1996 from Queensland. The main characters given by Tafe & Greenwood (1996) are compared in Table 4. The most important difference of the new species compared with the known ones is the uropods' rami having a rectangular shape, being longer in males than in females, the endopod having eight lateral plus one terminal spine; and the uropod's peduncle being longer compared to pleonite 6 than in the other two species.

Genus *Vaunthompsonia* Bate, 1858

Vaunthompsonia cf. *cristata* Bate, 1858

Material

Near Pt. Maclaren, Thorney Passage, Whiting Ground, 3.5 fathoms, 8-8.30 pm, 2 March 1941, submarine light, leg. K. Sheard: three males, SAM C 5994.

In this material the pereopods are broken; however, one can infer the specimens are close to *V. cristata* based on the serrated margins of carapace and pleonite 6, and the anal valves each ending in a fine hair. All these characters are typical for this species.

Family LEUCONIDAE Sars, 1878

Genus *Ommatoleucon* Watling, 1991

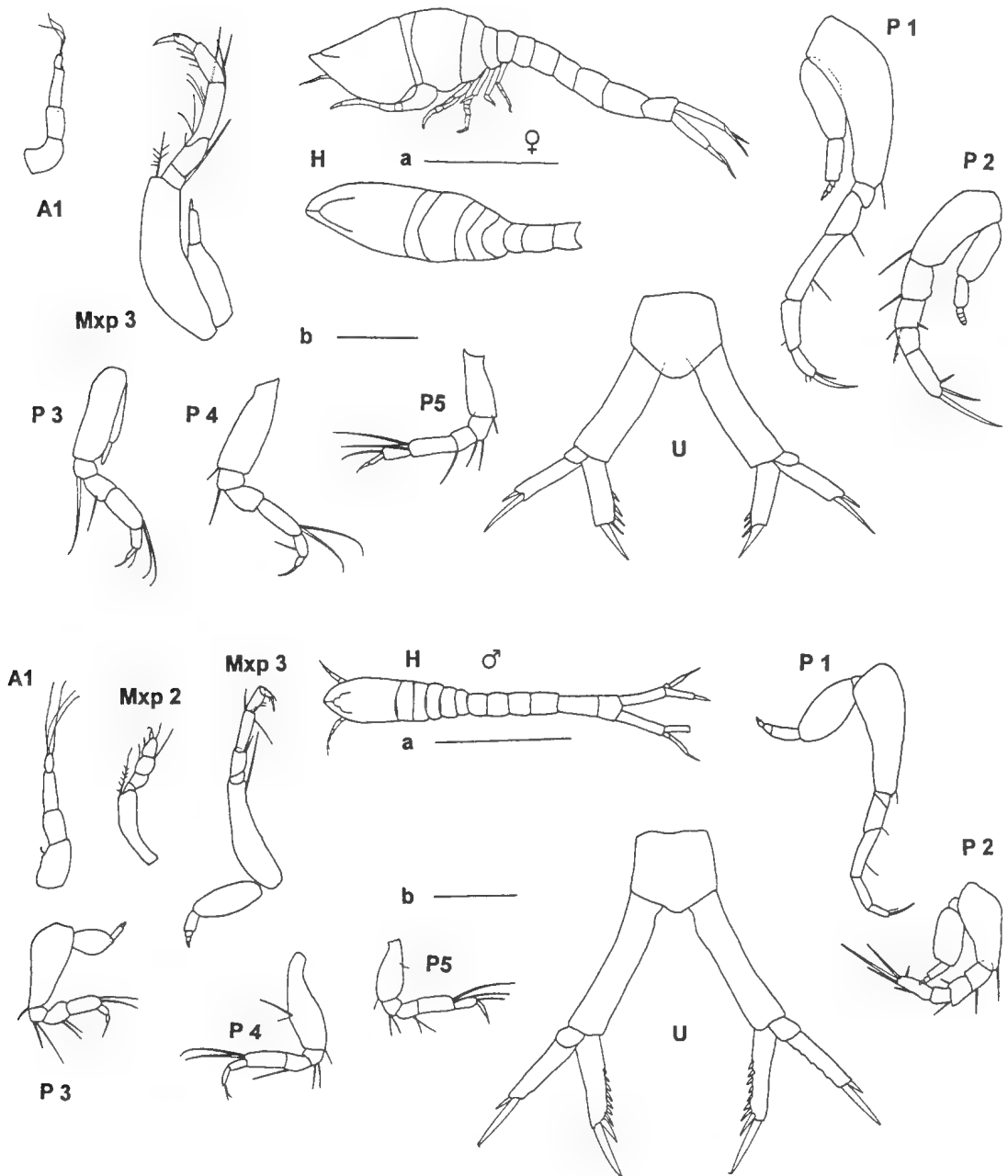


FIGURE 18: *Picrocuma rectangularis* sp.n. female (above): H: habitus, A1: first antenna, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 0.5 mm (H), scale b: 0.1 mm (A1, Mxp3, P1, P2, P3, P4, P5, U). *Picrocuma rectangularis* sp.n. male (below): H: habitus, A1: first antenna, Mxp2: maxilliped 2, Mxp3: maxilliped 3, P1: pereopod 1, P2: pereopod 2, P3: pereopod 3, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 0.5 mm (H), scale b: 0.1 mm (A1, Mxp2, Mxp3, P1, P2, P3, P4, P5, U).

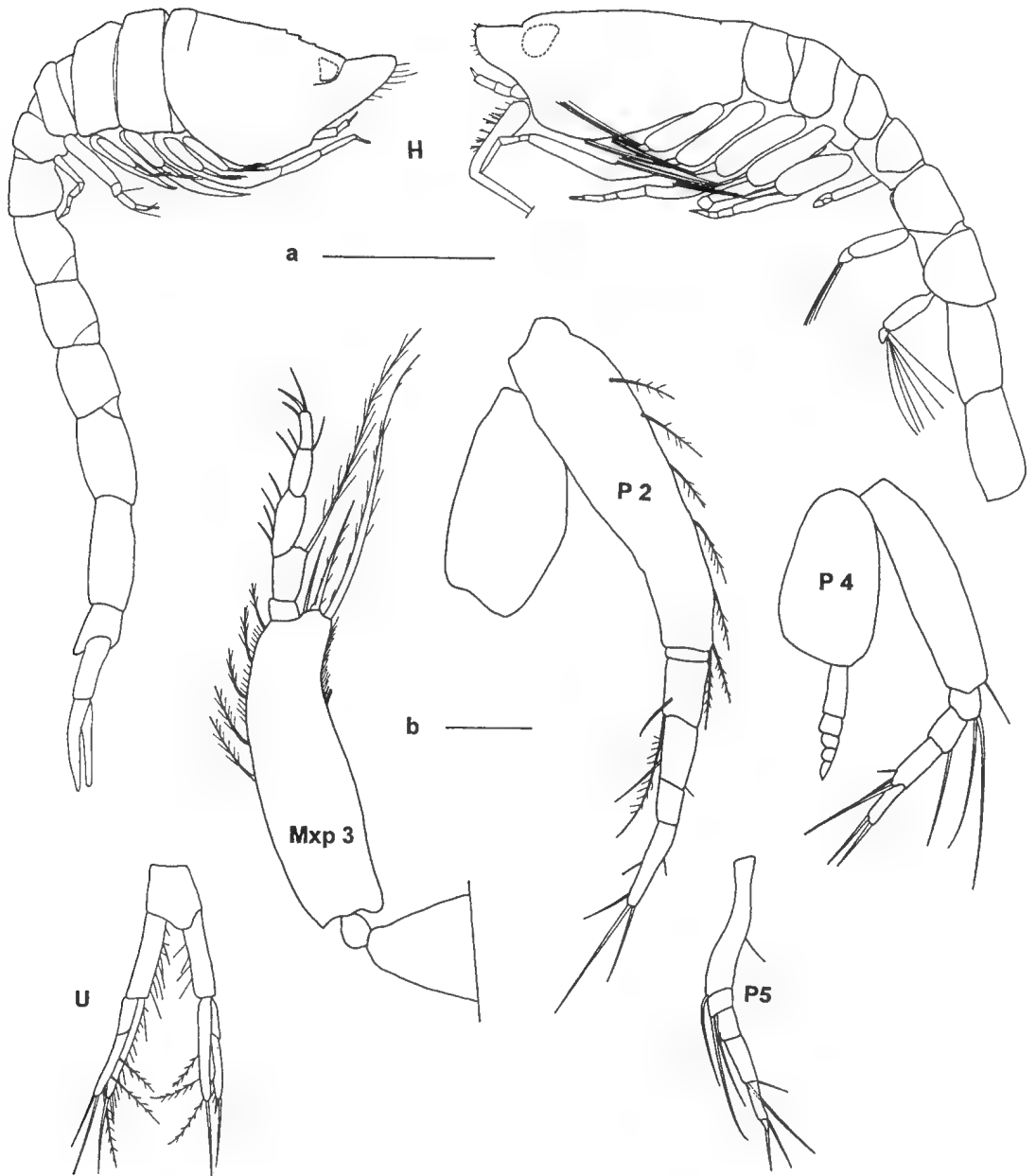


FIGURE 19: *Ommatoleucon ocularis*: H: habitus adult male (upper right) and subadult female (upper left), male's extremities: Mxp3: maxilliped 3, P2: pereopod 2, P4: pereopod 4, P5: pereopod 5, U: pleonite 6 and uropods. Scale a: 0.5 mm (H, U), scale b: 0.1 mm (Mxp3, P2, P4, P5).

Ommatoleucon ocularis (Hale, 1945)

(Figure 19)

Material

TAS: Nubeena: 6 males, 2 subadult females;
ZMH K 39937.

Remarks

The first record for members of the family Leuconidae from Tasmania fits well with the characteristics Hale (1945) gave for his new species, *Leucon ocularis*, which was transferred by Watling (1991) into his new genus *Ommatoleucon*. The diagnostic characters of this genus are: uropods' endopods unsegmented, straight pseudorostrum in front fringed with setae, ocular lobe not distinctly defined, eye present, pedigerous segments depressed, uropods' exopods with three unequal distal spines, inner margin with three plumose setae and a spine next to terminal three, endopod with 11 short spines at inner margin. The eye in the present specimens appears to be submerged in the carapace.

Distribution

South Australia, St. Vincent Gulf, 19 m;
Tasmania, Nubeena, 0.5 m.

ACKNOWLEDGMENTS

The sampling in the years 1975–76 by Drs G. Hartmann and G. Hartmann-Schröder was financially supported by the DFG. Sampling at Lizard Island in 1992 was allowed by permit No. G92/375, Great Barrier Reef Marine Park Regulations, Queensland.

Many thanks to:

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- H.-D. Totzke for critical comments;
- my husband Dr. V. Siegel for help with collecting and financial support;
- the Zoological Museum, Hamburg, for providing an actual place where the work involved could be undertaken.

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AN ANNOTATED CHECKLIST OF THE AUSTRALIAN ACANTHOCEPHALA FROM MAMMALIAN AND BIRD HOSTS

L. R. SMALES

Summary

A compilation of all the records of acanthocephalans parasiting Australian mammals and birds is presented, firstly as a parasite-host list and then as a host-parasite list. Current and original parasite and host names are given. References for and localities of each record are provided. Hosts from Australian sub-Antarctic and Antarctic waters are included but Papua New Guinea records are excluded.

AN ANNOTATED CHECKLIST OF THE AUSTRALIAN ACANTHOCEPHALA FROM MAMMALIAN AND BIRD HOSTS

LR SMALES

SMALES, LR. 2003. An annotated checklist of the Australian Acanthocephala from mammalian and bird hosts. *Records of the South Australian Museum* 36(1): 59–82.

A compilation of all the records of acanthocephalans parasitising Australian mammals and birds is presented, firstly as a parasite–host list and then as a host–parasite list. Current and original parasite and host names are given. References for and localities of each record are provided. Hosts from Australian sub-Antarctic and Antarctic waters are included but Papua New Guinea records are excluded.

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A list of type specimens of the Acanthocephala held in the South Australian Museum was compiled by Smales (1983), followed by a complete list of the Australian Acanthocephala by Edmonds (1989), more than 10 years ago. Since then new species have been described, additional material has been collected and many host and parasite taxa have been revised. It is, therefore, timely to produce updated lists that treat all the known acanthocephalans from Australian hosts.

This checklist is a compilation based on all published records up to 2002, augmented by the examination of all the specimens deposited in the Queensland Museum, Brisbane (QM); South Australian Museum, Adelaide (SAM); registration numbers prefixed as AHC, Australian Museum, Sydney (AM); the South Australian Research & Development Institute, Adelaide (SARDI); and the CSIRO Wildlife Collection, Canberra (CSIRO). It is limited to data from mammalian and bird hosts, including presumed paratenic hosts and accidental hosts; fish hosts are presently being reviewed (Pichelin, pers. comm.), amphibian hosts were recently treated by Barton (1994) and reptilian hosts by Pichelin et al (1999).

Although for the most part restricted to records of parasites from the Australian states, records from marine hosts collected from Australian sub-Antarctic and Antarctic territories have also been included. In these latter cases only material held in Australia is listed although the known distribution of such species may be circumpolar.

Parasite nomenclature is based on the system of classification of Amin (1985, 1987) and Golvan's (1994) alphabetical list of genera and species. Host nomenclature is based on Strahan (1995) for

the mammals, and Marchant and Higgins (1990–2001) and Schodde and Mason (1999) for the birds.

Each record is given using the current parasite name followed by its synonyms. Because there have been numerous changes to the taxonomy of many species, all known synonyms of the parasite are listed although some earlier records could not be accessed directly. This is followed by each host, with localities, specific references to Australian material, and museum registration numbers. If the current name of the host differs from that used in the original reference it is given as 'host as ...' after the reference in the host–parasite list. The type host is designated by an asterisk.

The following abbreviations are used for localities: NSW (New South Wales), NT (Northern Territory), Q (Queensland), V (Victoria), T (Tasmania), SA (South Australia), WA (Western Australia).

PARASITE–HOST LIST

CLASS ARCHIACANTHOCEPHALA

Gigantorhynchidae Hamman, 1892

1. *Mediorhynchus alecturae* (Johnston & Edmonds, 1947)

Syns: *Echinorhynchus* (*Gigantorhynchus*) sp. Johnston, 1912; Johnston & Deland, 1929

Empodius alecturae Johnston & Edmonds, 1947

Empodisma alecturae Yamaguti, 1963

Mediorhynchus alecturae Golvan, 1962; Byrd &

- Kellog, 1971; Schmidt & Kuntz, 1977; Smales, 2002a
 Host: *Alectura lathamii* Gray,* Q, Johnston 1912a: 106, 1912b: 72; Johnston & Deland 1929: 148; Smales 2002a: 375; AHC 1186, 2930, 4128, 2250, 427470-78, 42918-23.
2. *Mediorhynchus colluricinclae* Smales, 2002
 Hosts: *Acanthochoera chrysoptera* (Latham), SA, Smales 2002a: 377-380; AHC 4627
Coluricincla harmonica (Latham)*, SA, Smales 2002a: 377-380; AHC 5081, 5102, 18796, 28396
Pomatostomus superciliosus (Vigors & Horsfield), SA, Smales 2002a: 377-380; AHC 5118
Rhipidura leucophrys (Latham), SA, Smales 2002a: 377-380; AHC 5040.
3. *Mediorhynchus corcoracis* Johnston & Edmonds, 1951
 Syn: *Echinorhynchus* sp. Cleland, 1922; Johnston & Deland, 1929a
 Hosts: *Corcorax melanoramphos* (Vieillot)*, NSW, Q, SA, V, Cleland 1922: 108; Johnston & Deland 1929: 151; Johnston & Edmonds 1951:1-3; Smales 2002a: 375; AHC 3365, 3366, 3426, 5091, 6561, 23814, 42481-503
Corvus bennetti North, SA, Johnston & Edmonds 1951:1-3; Smales 2002a: 375; AHC 3269
Corvus coronoides Vigors & Horsfield, SA, Smales 2002a: 375; AHC 5086
Corvus mellori Matthews, SA, V, Smales 2002a: 375; AHC 5088, 5108, 5109, 11530, 18225
Corvus tasmanicus Matthews, Tas, AHC 4586, 4633.
Corvus sp. SA, AM W1056, W1065
 'crow', SA, NT, Smales 2002a: 375; AHC 1056, 1065, 3361
Grallina cyanoleuca (Latham), SA, NT, Smales 2002a: 375; AHC 434, 18222.
4. *Mediorhynchus robustus* Van Cleave, 1916
 Syns: *Mediorhynchus garruli* Yamaguti, 1939
Mediorhynchus robustus Van Cleave, 1916; Schmidt & Kuntz, 1977
 Host: *Grallina cyanoleuca* (Latham), Q, Smales 2002a: 375; QM GL11212 Specimens collected by J.W. Fielding, 1912, identified by H.H. Baylis, 1926, are now missing. This identification is doubtful but cannot be confirmed.
5. *Mediorhynchus* sp. A
 Host: *Stiltia isabella* Vieillot, NT, Smales 2002a: 375; CSIRO A21, identification by G. Schmidt but material missing from the collection.
6. *Mediorhynchus* sp. B
 Hosts: *Acanthogenys rufogularis* Gould and 'gull', SA, Smales 2002a: 375; AHC 5126, 20640, 2 female specimens and 1 fragment only available for study.
7. *Mediorhynchus* sp. larvae
 Presumed paratenic host: *Isoodon macrourus* (Gould), Q.
- Moniliformidae**
8. *Australiformis semoni* (Linstow, 1898)
 Syns: *Echinorhynchus semoni* Linstow, 1898
Prosthenorchis s.l. semoni Travassos, 1917
Gigantorhynchus sp. Johnston, 1910a; Johnston & Deland, 1929
Gigantorhynchus semoni Porta, 1908; Johnston, 1909a, 1911; Johnston & Deland, 1929
Moniliformis semoni Johnston & Edmonds, 1952
Australiformis semoni Schmidt & Edmonds, 1989
 Hosts: *Antechinus agilis* Dickman et al, AHC 19728-32, CSIRO A31, A36, A48, *Antechinus stuartii* Macleay, Schmidt & Edmonds 1989: 215-217
Isoodon macrourus (Gould), Q, NT, AHC 3416, 10512, 17994, 23308, 23309, 23316, CSIRO A5, A6, A9, A61, A67, A107, QM GL14429, GL14431, GL14433, GL14437, GL14438, GL14440, GL14441, GL14442, GL14443, GL14464, GL14465
Isoodon obesulus (Shaw)*, NSW, Q, T, WA, Linstow 1898: 471; Johnston 1909a: 521; Johnston & Edmonds 1952: 215-217; Schmidt & Edmonds 1989: 215-217; AHC 4090, 8325, 17929, 17930, 17931, 17932, 17980-91, 18038, 18041, 18207, 18208 42513-22, CSIRO A90, A92
Perameles gunnii Gray, T, V, Schmidt & Edmonds 1989: 215-217; AHC 5036, 5037, 5049, 5087, 11424, 11430, 16348, 16350, 16351, 17928, 17992, 17993, 18039, 18117, 18175, 18213, 23302, 23305, 23317, 23320, 23322, 23327, 23328, 23329, 16348, 16350, 16351, 17928, CSIRO A2, A14
Perameles nasuta Geoffroy, NSW, Q, Johnston 1910: 27, 1911: 50; Johnston & Edmonds

- 1952: 215-217; Schmidt & Edmonds 1989: 215-217; AHC 5093, CSIRO A3, A7, A66, QM GL14430, GL14436, G211343
- Phascogale tapoatafa* (Meyer), NSW, Johnston 1910: 27, 1911:50; Johnston & Edmonds 1952: 18-20; Schmidt & Edmonds 1989: 215-217
- Potorous tridactylus* (Kerr), T, AHC 10069, 18577, 17995
- Bandicoot, no locality data, Q, T, AHC 3394, 3395, 3404, 7850, 17978, 17995, 18576.
9. *Moniliformis moniliformis* (Bremser, 1811)
 Syns: *Echinorhynchus moniliformis* Bremser, 1811
E. grassi Deffke, 1891; *E. canis* Porta, 1914; *E. belgicus* Railliet, 1918
Gigantorhynchus Hamman, 1892 *pro parte*
Gigantorhynchus moniliformis Porta, 1908; Johnston, 1909b, 1909c, 1909d, 1912b, 1913, 1916; Nicoll, 1914
Hormorhynchus moniliformis Johnston, 1918a; Fielding, 1927; Southwell & McFie, 1925
Moniliformis moniliformis Travassos, 1915, *nec M. moniliformis sensu* Travassos, 1917 see Golvan, 1994; Johnston & Edmonds, 1952
Moniliformis dubius Meyer, 1932; Johnston & Deland, 1929; Meyer, 1933
 Hosts: *Rattus rattus* (Linn.), NSW, Q, SA, Johnston 1909d: 583, 1909b: 218, 590, 1909c: 81, 1912b: 83, 1916: 43; Johnston 1918a: 69; Fielding 1927: 123; Southwell & McFie 1925: 171; Johnston & Deland 1929: 147; Johnston & Edmonds 1952: 20-21; AHC 42507, 42508, 42510
Rattus norvegicus (Berkenhout), NSW, Q, NT, SA, Johnston 1909b: 218, 590, 1909c: 81, 1912b: 83, 1913: 93, 1916: 43; Johnston 1918a: 69; Fielding 1927: 123; Southwell & McFie 1925: 171; Johnston & Deland 1929: 147; Johnston & Edmonds 1952: 20-21; Edmonds, 1989: 127; QM GL11008, GL11068, GL11091, GL14434, AHC 2486, 3419, 42504, 42505, 42506, 42509, 42511
Rattus fuscipes (Waterhouse) Edmonds, 1989: 128
 rat, *Rattus spp.*, NSW, Q, Nicoll 1914: 4; AM W305, W1602, QM GL11572, GL11703, AHC 42512.
- Oligocanthorhynchidae
10. *Macracanthorhynchus hirudinaceus* (Pallas, 1781)
 Syns: *Taenia haeruca* Pallas, 1766 *pro parte*, *T. hirudinaceus* Pallas, 1781
Echinorhynchus hirudinaceus Pallas 1781; *E. gigas* Bloch, 1782
Gigantorhynchus hirudinaceus Porta, 1908; Johnston, 1909a, 1909c
Homorhynchus hirudinaceus Johnston, 1918b
Gigantorhynchus gigas Meyer, 1928
Macracanthorhynchus hirudinaceus Travassos, 1917; Johnston & Deland, 1929
 Host: *Sus scrofa* Linn.,* Q, NSW, SA, V, Johnston 1909d: 583, 1909c: 79, 1918b: 216; Johnston & Deland 1929: 147; AHC 1596, 2471, 3422, 8480, 15473, 18500, 18903, 19018, 22539, AM W5549, W201622, SARDI A110.
11. *Multisentis myrmecobius* Smales, 1997
 Host: *Myrmecobius fasciatus* Waterhouse,* WA, Smales 1997: 301-307; AHC 30021, 30022, 30034-35, 30091-93, 30096.
12. *Oncicola pomatostomi* (Johnston & Cleland, 1911)
 Syns: *Echinorhynchus pomatostomi* Johnston & Cleland, 1911; Johnston & Deland, 1929
Echinorhynchus s.l. pomatostomi Petrochenko, 1958
Oligocanthorhynchus pomatostomi Tubangi, 1933
Oncicola sp. Banks, 1952; Edmonds, 1957a
Oncicola pomatostomi Schmidt, 1983
 Paratenic hosts: *Acanthiza chrysorrhoa* (Quoy & Gaimard), SA, WA, Mawson et al 1986: 273
Amytornis purnelli Mathews, WA, Mawson et al 1986: 272
Anthochaera carunculata (White), WA, Mawson et al 1986: 274; AHC 4684
Anthus novaeseelandiae (Gmelin), WA, Mawson et al 1986: 266
Aphelocephala leucopsis Gould, SA, Cleland 1922: 108; Schmidt 1983: 397-399; CSIRO A34
Artamus cinereus Vieillot, NT, Q, Mawson et al 1986: 281; AHC 18217
Artamus superciliosus (Gould), Edmonds 1989: 128
Cinclosoma castonotus Gould, SA, Johnston & Deland 1929: 149; Schmidt 1983: 397-399
Cinclosoma cinnamomeum Gould, SA, NT, Johnston & Deland 1929: 149; Schmidt 1983: 397-399; Mawson et al 1986: 270; AHC 4896
Climacteris affinis (Blythe), AHC 18212

- Climacteris leucopsis*, AHC 1801
- Climacteris melanura* Gould, WA, Mawson et al 1986: 274; Schmidt 1983: 397-399
- Climacteris picumnus* Temminck, SA, Cleland 1922: 108; Johnston & Deland 1929: 150; Schmidt 1983: 397-399; AHC 5099
- Colluricincla harmonica* (Latham), SA, AM W1079
- Cormobates leucophaea* (Latham), SA, Johnston & Deland 1929: 151; Schmidt 1983: 397-399
- Daphoenositta chrysoptera* (Latham), NT, WA, Mawson et al 1986: 273; CSIRO A40, A47
- Grallina cyanoleuca* (Latham), NT, Mawson et al 1986: 281; AHC 5110
- Gymnorhina tibicen* (Latham), NT, SA, Mawson et al 1986: 282
- Hylacola* sp., no locality data, AHC 8863
- Lalage leucomela* (Vigors & Horsfield), NT, Mawson et al 1986: 267
- Lichenostomus plumulus* (Gould), WA, Mawson et al 1986: 276
- Lichenostomus virescens* (Viellot), WA, Mawson et al 1986: 276
- Malurus cyaneus* (Ellis), SA, AHC 28011
- Manorina flavigula* (Gould), NT, SA, WA, Mawson et al 1986: 275; CSIRO A32
- Melanodryas cucullata* (Latham), NT, Mawson et al 1986: 267
- Microeca leucophaea* (Latham), Q, Mawson et al 1986: 268
- Nycticorax caledonicus* (Gmelin), Q, CSIRO A46
- Oreoica gutturalis* (Vigors & Horsfield), NT, Mawson et al 1986: 269
- Pachycephala inornata* Gould, SA, Johnston & Cleland 1911: 115; Schmidt 1983: 397-399
- Pachycephala rufiventris* (Latham) NT, Mawson et al 1986: 268; Schmidt 1983: 397-399
- Pedionomus torquatus* Gould, SA, Johnston & Deland 1929: 148; Schmidt 1983: 397-399; AM W955
- Petroica goodenovii* Vigors & Horsfield, NT, CSIRO A33
- Poephila cincta* (Gould), Q, Mawson et al 1986: 279
- Pomatostomus halli* (Cowles), Q, CSIRO A57
- Pomatostomus ruficeps* (Hartlaub), SA, Johnston & Deland 1929: 150; Schmidt 1983: 397-399; AHC 557, 5072, CSIRO A56, SARDI A112-3
- Pomatostomus superciliosus* (Vigors & Horsfield), (*paratenic), NT, Q, SA, WA, Johnston 1910: 107; Johnston & Cleland 1911: 112; Cleland 1922: 107; Schmidt 1983: 397-399; AHC 1729, 1804, 2707, 5054, 5074, 5077, 5078, 42537, 42538, AM W293, CSIRO A27
- Pomatostomus temporalis* (Vigors & Horsfield), NSW, NT, Q, WA, Johnston & Cleland 1911: 112; Cleland 1922: 108, Mawson et al 1986: 270; Schmidt 1983: 397-399; AHC 18459, CSIRO A104, SARDI A112-9
- Sericornis brunneus* (Gould), SA, WA, Johnston & Deland 1929: 150; Mawson et al 1986: 272; AHC 28012, 28013, AM W1080
- Sericornis cautus* (Gould), SA, Mawson et al 1986: 272
- Sericornis fuliginosus* (Vigors & Horsfield), WA, Mawson et al 1986: 272; CSIRO A26
- Sericornis pyrrhopygius* (Vigors & Horsfield), SA, Johnston & Cleland 1911: 112; Schmidt 1983: 397-399; AHC 1802
- Strepera versicolor* (Latham), SA, CSIRO A60
- Turnix castanota* (Gould), SA, Mawson et al 1986: 246; AHC 5073
- Turnix velox* (Gould), Q, Mawson et al 1986: 246
- Zoothera dauma* (Latham), Q, SA, Schmidt 1983: 397-399; AHC 3369
- Zoothera lunulata* (Latham), Schmidt, 1983: 397-399
- bird, SA, WA, AM W889, W1078
- Definitive hosts: *Felis catus* Linn.,* NSW, NT, SA, V, Schmidt 1983: 397-399; AHC 9565, 15077, 18196, 18444-48, 18460, 18462-67, 30181-93, 30438, CSIRO A12, SARDI A112 -2, 4-8
- Canis familiaris dingo* Blumenbach, NT, Edmonds 1957a: 79; Schmidt 1983: 397-399; AHC 18443, 18461, SARDI A112-1.

CLASS PALAEACANTHOCEPHALA

Centrorhynchidae

13. *Centrorhynchus asturinus* (Johnston, 1912)
 Syns: *Gigantorhynchus* (*sensu latum*) Travassos, 1917
- Gigantorhynchus asturinus* Johnston, 1912a, 1913
- Centrorhynchus asturinus* Johnston, 1918b; Travassos, 1926; Southwell & McFie, 1925; Johnston & Deland, 1929; Golvan, 1956a; Petrochenko, 1958; Yamaguti, 1963 as *C. asturinum*
- Echinorhynchus bazae* Southwell & McFie, 1925
- Prosthorhynchus bazae* Travassos, 1926
- Gordiorhynchus falconis* Johnston & Best, 1943; Petrochenko, 1958

Centrorhynchus falconis Golvan, 1956a

Hosts: *Accipiter cirrocephalus* (Vieillot), NSW, Q, Southwell & McFie 1925: 163; Johnston & Deland 1929: 148; QM GL11509

Accipiter fasciatus (Vigors & Horsfield), NSW, NT, SA, Southwell & McFie 1925: 163; Johnston & Deland 1929: 148; AHC 3377, 8860, 42208-09

Accipiter novaehollandiae (Gmelin),* Q, Johnston 1912a: 108, 1913: 93; Southwell & McFie 1925: 164; AHC 950, 42203, 42205-07, QM GL11064, GL11213, G213458

Aviceda subcristata (Gould), NSW, Q, Johnston 1918: 215; Southwell & McFie 1925: 177; AHC 3371

Circus approximans Peale, NSW, Q, SA, Johnston 1918: 216; Mawson et al 1986: 244

Falco berigoria Vigors & Horsfield, NSW, NT, Q, SA, Southwell & McFie 1925: 164; Johnston & Deland 1929: 148; Mawson et al 1986: 245; AHC 5039, 5080, 19594, 42213-13, QM GL11200

Falco cenchroides Vigors and Horsfield, Q, SA, Mawson et al 1986: 246; AHC 5119, 5817, 19595

catbird or crested hawk, AHC 8874.

14. *Centrorhynchus bancrofti* (Johnston & Best, 1943)

Syns: *Echinorhynchus* sp. Johnston, 1912

Gordiorhynchus sp. Johnston, 1918; *Gordiorhynchus bancrofti* Johnston & Best, 1943

Centrorhynchus bancrofti Golvan, 1956a

Presumed paratenic hosts: *Antechinus agilis* Dickman et al, NSW, V, AHC 16299, CSIRO A17, A30, A35, A39, A43, A73, A78, A81, A85, A86, A88

Antechinus stuartii Macleay, NSW, QM G213754

Antechinus swainsonii (Waterhouse), NSW, CSIRO A23, A25, A72, A82, A84

Hosts: *Ninox boobook* (Latham), NSW, Q, SA, Johnston 1912a: 109; Johnston 1918b: 216; AHC 42210-11

Ninox strenua (Gould),* Q, Johnston & Best 1943: 226; Mawson et al 1986: 262; AHC 5060, 5101, 5114, 18057, CSIRO A68.

15. *Centrorhynchus horridus* (Linstow, 1897)

Syns: *Echinorhynchus horridus* Linstow, 1897; Marval, 1905

Echinorhynchus sp. Johnston, 1910b; Johnston & Deland, 1929

Prosthorhynchus horridus Travassos, 1926

Centrorhynchus horridus Meyer, 1932; Johnston & Edmonds, 1948, 1958; Golvan, 1956a; Yamaguti, 1963, as *C. horridum*

Hosts: *Dacelo novaeguineae* (Hermann), Q, SA, Mawson et al 1986: 264; AHC 941, 5098, 18044, 42224-25, QM G207576

Todiramphus macleayii (Jardine & Selby), Q, CSIRO A65

Todiramphus sanctus (Vigor and Horsfield),* Q, Johnston 1910b: 105; Johnston & Edmonds 1948: 69; AHC 5057, 5124, 18802, 42214-23, QM G207319, G207575

Dacelo sp., Q, AHC 5130, 18187

kookaburra, Q, QM G207282.

16. *Centrorhynchus* sp. A

Host: egret, Q, single immature specimen; proboscis armature not consistent with described species from Australian localities, QM G207066.

17. *Centrorhynchus* sp. B

Hosts: kingfisher, no locality data, AHC 5123

hawk, no locality data, AHC 5134.

18. *Centrorhynchus* spp.

Presumed paratenic hosts: *Antechinus agilis* Dickman et al, NSW, V, CSIRO A35, A42, A79, A87, A105

Antechinus swainsonii (Waterhouse) NSW, CSIRO A18, A37

Phascogale tapoatafa (Meyer), NSW, CSIRO A103

Sminthopsis leucopus (Gray), T, CSIRO A22.

Plagiorhynchidae

19. *Plagiorhynchus charadrii* (Yamaguti, 1939)

Syn: *Prosthorhynchus charadrii* Yamaguti, 1939; Johnston & Edmonds, 1947

Plagiorhynchus charadrii Van Cleave, 1951 *nec* Golvan, 1956b; Schmidt and Kuntz, 1966; Smales, 2002b

Hosts: *Acridothores tristis* Linn., V, Smales 2002b: 210; AHC 8648

Centropus phasianus Latham, Q, Smales 2002b: 210; AHC 1790, 1793, 1796
Charadrius alexandrius Linn., SA, T, Smales 2002b: 210; AHC 5046, 5061, 5070
Charadrius ruficapillus Temminck, SA, T, Mawson et al 1986: 251; AHC 5116, 18040, 18191

- Haematopus fuliginosus* Gould, T, Smales 2002b: 210; AHC 7731
- Haematopus longirostris* Vieillot, T, Smales 2002b: 210; AHC 7730
- Pachyptila tutur* (Kuhl), T, Smales 2002b: 210; AHC 8862
- Thinornis rubricollis* (Gmelin), V, SA, Johnston & Edmonds 1947: 561; AHC 3362, 5075, 5083, 15595, 18779, 42426-37
- Turdus merula* Linn., T, Smales 2002b: 210; AHC 8876.
- 20. *Plagiorhynchus cylindraceus*** (Goeze, 1782)
 Syns: *Echinorhynchus cylindraceus* Goeze, 1782; *E. brumpti* Blanc and Cauchemez, 1911; *E. pici* Gmelin, 1791; *E. musicapae* Rudolphi, 1819; *E. dimorphocephalus* Westrumb, 1821; *E. obliquis* Dujardin, 1845; *E. pigmentatus* Marval, 1902
- Centrorhynchus cylindraceus* Schrank, 1788; Travassos, 1926; Petrochenko, 1958
- Prosthorhynchus* Kostylev, 1915; Yamaguti, 1963 as *P. cylindraceus*; Golvan, 1956a, 1956b; Edmonds, 1982
- Prosthorhynchus genitopapillatus* Lundstrom, 1942 see Golvan, 1994
- Prosthorhynchus upupae* Lopéz-Neyra, 1946
- Plagiorhynchus cylindraceus* Schmidt and Kuntz, 1966; Schmidt, 1981; Amin et al, 1999; Smales, 1988, 2002b
- Presumed paratenic hosts: *Antechinus agilis* Dickman et al, NSW, CSIRO A74
- Hydromys chrysogaster* Geoffroy; Edmonds 1989: 130; AHC 19690
- Isodon obesulus* (Shaw); T, Smales 1988: 1062-4; AHC 18827, 18988, 19013, 19014, CSIRO A94, A95
- Isodon macrourus* (Shaw), ACT, CSIRO A93
- Perameles gunnii* (Gray), T, CSIRO A96
- Wallabia bicolor* (Desmarest), NSW, AHC 7307
- Sminthopsis leucopus* (Gray), V, AHC 6559
- Potorous tridactylus* (Kerr), T, CSIRO A108
- Vulpes vulpes* Linn., V, AHC 6555
- Hosts: *Acridotheres tristis* Linn., V, Edmonds 1989: 130; AHC 18034, 23847
- Corvus coronoides* Vigors & Horsfield, V, Smales 2002b: 210; AHC 18812, 18825
- Gallina tenebrosa* Gould, V, Smales 2002b: 210; AHC 18087
- Grallina cyanoleuca* (Latham), V
- Gymnorhina tibicen* (Latham), T, V, Smales 2002b: 210; AHC 8877, 18035, 18226, 19046
- Megalurus timoriensis* Wallace, Johnston & Deland 1929: 150; doubtful record
- Sturnus vulgaris* Linn., T, V, Smales 2002b: 210; AHC 18186, 18203, 19426, 23849
- Threskiornis molucca* (Cuvier), T, Smales 2002b: 210; AHC 18182, 18205
- Turdus merula* Linn., T, V, Edmonds 1989: 130; AHC 8879, 10011, 11381, 18033, 23850, 23851
- Vanellus miles* (Boddaert), T, V, Smales 2002b: 210; AHC 18021
- Zoothera lunulata* (Latham), V, AHC 32105
- pigeon, Schmidt 1981: 597; AHC 23848
- Hydromys chrysogaster* Geoffroy; T, AHC 18183, 18209
- Perameles gunnii* (Gray), T, Smales 1988: 1062-64; AHC 18184, 18206, 19012
- 21. *Plagiorhynchus menurae*** (Johnston, 1912)
 Syns: *Echinorhynchus menurae* Johnston, 1912b
- Prosthorhynchus menurae* Travassos, 1926; Meyer, 1933; Johnston & Best, 1943; Petrochenko, 1958, attributed in error to Schaston, 1912
- Plagiorhynchus menurae* Golvan, 1956; Schmidt and Kuntz, 1966; Smales, 2002b
- Hosts: *Menura alberti* Bonaparte, NSW, Smales 2002b: 21; CSIRO A100, A101
- Menura novaehollandiae* Latham,* NSW, V, Johnston 1912b: 88; Johnston & Best 1943: 226; AHC 6552, 17951, 17952, 17976, 18045, 18575, 22934, 32135, 42438-41, CSIRO A50, A51, A52, A69, A70, A71, A89, A91.
- 22. *Plagiorhynchus* sp.** Smales, 2002: 210
 Hosts: *Psophodes olivaceus* (Latham), NSW, CSIRO A55
- Ptiloris victoriae* Gould, Q, CSIRO A63.
- 23. *Plagiorhynchus* spp.**
 Possibly *P. cylindraceus* but cyst forms difficult to determine with certainty
- Presumed paratenic hosts: *Antechinus agilis* Dickman et al, NSW, CSIRO A24, A41
- Antechinus stuartii* Macleay, NSW, QM GL 12584 slide no 213755
- Isodon macrourus* (Shaw), ACT, CSIRO A98
- Isodon obesulus* (Shaw), ACT, CSIRO A95
- Sminthopsis leucopus*, NSW, CSIRO A19.
- 24. *Porrorchis hylae*** (Johnston, 1914)
 Syns: *Echinorhynchus* sp. Johnston, 1912b

Echinorhynchus hylae Johnston, 1914; Petrochenko, 1958 as *Echinorhynchus s.l. hylae*; *E. bulbocaudatus* Southwell & McFie, 1925; Johnston and Deland, 1929; *E. centropusi* Tubangi, 1933

Prosthorhynchus bulbocaudatus Travassos, 1926
Gordiorhynchus hylae Johnston and Edmonds, 1948

Pseudoporrorchis hylae Joyeaux and Baer, 1935; Edmonds, 1957a

Porrorchis hylae Schmidt & Kuntz, 1967; Smales, 2002b

Presumed paratenic host: *Antechinus stuartii* Macleay, NSW, QM GL 12584 Slide No 213753, GL12593

Hosts: *Burrhinus grallarius* (Latham), Q, Smales 2002b: 210; QM G207024

Centropus phasianus (Latham),* NT, Q, WA, AHC 5064, 5103, 5121, 18216, 18838 CSIRO A64, QM GL11402, G207272, G207473; Johnston & Deland 1929: 149; Edmonds 1957a: 76; Mawson et al 1986: 262; Smales 2002b: 210

Podargus strigoides (Latham), NT, Q, SA, Johnston & Edmonds 1948: 74; Mawson et al 1986: 263; Smales 2002b: 210; AHC 857, 3411 (listed as types in the register but the species was first described from *C. phasianus*), 4606, 5084, 5129, 6553, 6562, 11214 15221, 18211, 18218, 18220, 18221, 42542-47, QM G207057, G207103, G207193.

25. *Porrorchis hydromuris* (Edmonds, 1957)

Syns: *Pseudoporrorchis hydromuris* Edmonds, 1957a

Porrorchis hydromuris Schmidt and Kuntz, 1967; Smales, 2002b

Hosts: *Hydromys chrysogaster* Geoffroy,* Q, Edmonds 1957a: 77; Smales 2002b: 210; AHC 3398, 3402, 5056, 5079, QM GL14411, GL14432, GL14435, GL14460-63, GL14466 rat, QM GL14374.

26. *Porrorchis* sp.

Host: *Felis catus* Linn., NSW, possibly Q, Smales 2002b: 210; AHC 3414, QM GL12464.

Polymorphidae

27. *Andracantha clavata* (Goss, 1940)

Syns: *Corynosoma clavatum* Goss, 1940; Johnston & Best, 1942; Johnston & Edmonds, 1953; Edmonds, 1955, 1957; Zdzitowiecki, 1986a, 1986b; Edmonds, 1989

Andracantha clavata: Zdzitowiecki, 1989, 1991

Hosts: *Cygnus atratus* (Latham), SA, AHC 3002, 3016

Eudiptula minor (Forster), V

Leucocarbo atriceps (King), Heard Is., Macquarie Is., Edmonds 1955: 141, 1957: 96; AHC 18021, CSIRO A20

Leucocarbo colensoi Buller, Auckland Is., Campbell Is., Johnston & Edmonds 1953: 59

Leucocarbo fuscescens Viellot, SA, AHC 5058, 11213

Phalacrocorax melanoleucos Viellot, V, SA, WA, Goss 1940: 12; Mawson et al 1986: 232; AHC 3384

Phalacrocorax sulcirostris (Brandt), SA, WA, Goss 1940: 12; Mawson et al 1986: 231; AHC 18359

Phalacrocorax varius (Gmelin),* SA, WA, Goss 1940: 12; Johnston & Best 1942: 252; AHC 2698, 15434, 42274

Phalacrocorax verrucosus (Cabanis), Kerguelen Is., Edmonds 1957b: 96

Phalacrocorax sp. Macquarie Is., AHC 18468

shag, WA, Goss 1940: 12-13; WAM WA73-83

Accidental host: *Arctocephalus pusillus* (Schreber), SA, Johnston & Best 1942: 253; AHC 22536.

28. *Andracantha* sp.

Identified as *Corynosoma phalacrocoracis* Yamaguti, 1939: 337-338 now *Andracantha phalacrocoracis*, Schmidt, 1975: 618-619. Specimens possibly collected on the British, Australian and New Zealand Antarctic Expedition of 1929-31. Probosces missing, therefore identification can't be confirmed.

Host: *Leucocarbo atriceps* (King), 'Antarctic' AHC 22639.

29. *Arthromorhynchus johnstoni* Golvan, 1960

Syns: *Arythmorhynchus frassoni* Johnston & Edmonds, 1951

Arythmorhynchus johnstoni Golvan, 1960; Edmonds, 1971

Host: *Numenius madagascarensis* (Linn.),* Q, Johnston & Edmonds 1951: 3; Edmonds 1971: 60; AHC 22554, 42183, 42184, AM W4571, QM GL11209 (specimen missing).

30. *Arythmorhynchus limosae* Edmonds, 1971

Host: *Limosa lapponica* (Linn.),* Q, Edmonds 1971: 58; AHC 42185-89, QM GL12403,

- GL12406, GL12415, GL12445, G213743, G213744.
31. *Bolbosoma baleanae* (Gmelin, 1790)
 Syns: *Sipunculus lendix* Phipps, 1774
Echinorhynchus balaenae Gmelin, 1790, *E. porrigens* Rudolphi, 1814; *E. mysticeti* Beneden, 1870
Bolbosoma balanae Van Cleave, 1953 in error, see Golvan, 1994
Bolbosoma porrigens Johnston & Deland, 1929; Meyer, 1932
Bolbosoma balaenae Petrochenko, 1958; Zdzitowiecki, 1991
 Hosts: *Balenoptera acutorostrata* Lacépède, Antarctic/ Pacific, AHC 30160, 30162
Globiocephala melas (Traill), SA, AHC 3423
 whale probably *Megaptera novaeangliae* (Borowski), NSW, Johnston & Deland 1929: 147; AHC 3423, 22544, AM G11124.
32. *Bolbosoma capitatum* (Linstow, 1880)
 Syns: *Echinorhynchus capitatus* Linstow, 1880
Bolborhynchus capitatus Porta, 1906
Bolbosoma capitatum Porta, 1908; Meyer, 1932; Edmonds, 1957a, 1987; Amin & Margolis, 1998
 Hosts: *Balaenoptera musculus* Linn., SA, AHC 18826
Globicephala melas (Traill) *Globicephala* sp., T, SA, Edmonds 1957a:78; AHC 11432
Pseudorca crassidens Owen, WA, SA, Edmonds 1957a: 78, 1987: 317; AHC 16308, 17979, 30159, WAM WA405-86
Physeter catodon Linn., T, AHC 10571
 Accidental hosts: *Arctocephalus forsteri* (Lesson), SA, AHC 19697
Arctocephalus pusillus doriferus (Schreber), V, T, AHC 32114, 32126, 32132.
33. *Bolbosoma turbinella* (Diesing, 1851)
 Syns: *Echinorhynchus balaenocephalus* Owen, 1803 see Golvan, 1994; *E. turbinella* Diesing, 1851
Bolborhynchus turbinella Porta, 1906
Pomphorhynchus turbinella Lieper & Atkinson, 1915 see Yamaguti, 1963
Bolbosoma turbinella Porta, 1908; Travassos, 1926; Baylis, 1929; Zdzitowiecki, 1991
 Host: *Balaenoptera musculus* Linn., SA, AHC 18826.
34. *Bolbosoma vasculosum* (Rudolphi, 1819)
 Syns: *Echinorhynchus vasculosus* Rudolphi, 1819; *E. auranticus* Risso, 1826; Diesing, 1851; *E. pellucidus* Leukart, 1828; *E. annulatus* Molin, 1858; *E. serrani* Linton, 1888, juvenile worm, may be synonym, see Golvan, 1994; *E. bifasciatus* Lühe, 1904
Bolbosoma aurantiacum Van Cleave, 1924; Travassos, 1926
Bolbosoma vasculosum Porta, 1908: 273-274; Petrochenko, 1958
 Host: *Mesoplodon bowdoini* (Andrews), NT, SA, AHC 30133
 Accidental host: *Arctocephalus pusillus doriferus* (Schreber) T, AHC 32106.
35. *Bolbosoma* sp.
 Host: *Pseudorca crassidens* (Owen), no locality data, AHC 30351
36. *Corynosoma arctocephali* Zdzitowiecki, 1984
Corynosoma singularis Skryabin & Nikolsky, 1971 *pro parte*; Hoberg, 1986
Corynosoma arctocephali Zdzitowiecki 1984a, 1986a, 1991; Hoberg, 1986
 Host: *Arctocephalus pusillus doriferus* (Schreber), Heard Island, AHC 12773.
37. *Corynosoma australe* Johnston, 1937
 Syns: *Corynosoma otarinae* Morini & Boreo, 1960
Corynosoma australe Johnston, 1937; Johnston & Edmonds, 1953; Vargara & George-Nacimiento, 1982; Zdzitowiecki, 1984a, 1986a, 1989; Smales, 1986; Pereira & de Matos Neves, 1993
 Hosts: *Arctocephalus forsteri* (Lesson), SA, AHC 19589, 30107, 41273
Arctocephalus pusillus doriferus (Schreber), V, SA, AHC 10047, 18763, 18886, 18941, 18945, 18947, 19119, 19384, 22345, 30107, 30134, 32115, 32129
Arctocephalus tropicalis (Gray), V (Zoo), SA, AHC 22972, 32108
Arctocephalus sp., SA, AHC 18931, 18934
Hydrurga leptonyx (Blainville) Auckland Is., Campbell Is., Johnston & Edmonds 1953: 58; Smales 1986: 94; AHC 42235, 42236
Mesoplodon layardi (Gray), SA, AHC 24768
Neophoca cinerea (Peron),* SA, Johnston 1937: 13; Smales 1986: 94; AHC 15474, 22824, 23088, 30114, 31367, 42226-29, 42237, 32115, 32116, 32119

- Phocarcetos hookeri* (Gray); Auckland Is., Campbell Is., Johnston & Edmonds 1953: 58; Smales 1986: 94; AHC 42231-34
- Tursiops truncatus* Montagu, V, AHC 24757, 32121
- Accidental hosts: *Eudyptula minor* Forster, V
- Leucocarbo atriceps* (King), Heard Is., AHC 42279, 42280.
38. *Corynosoma bullosum* (Linstow, 1892)
Syns: *Corynosoma mirabilis* Skryabin, 1966
Echinorhynchus bullosus Linstow, 1892;
Corynosoma strumosum sensu Gower, 1939 see Yamaguti, 1963
Corynosoma singularis Skryabin & Nickolsky, 1971, *pro parte*
Corynosoma bullosum Raillet & Henry, 1907; Baylis, 1929; Travassos, 1926; Johnston & Edmonds, 1953; Edmonds, 1955, 1957b; Zdzitowiecki, 1984a, 1986a, 1991; Hoberg, 1986
Hosts: *Mirouga leonina* Linn.,* Crozet Is., Heard Is., Macquarie Is., Marion Is., Johnston & Edmonds 1953: 55; Edmonds 1995: 142; Edmonds 1957b: 96; AHC 3396, 3804-10, 32107, 32131, 42240-65
Hydrurga leptonyx (Blainville), Heard Is., QM G213756-63
Accidental host: *Delphinus delphis* Linn., WA, AHC 18883.
39. *Corynosoma cetaceum* Johnston & Best, 1942
Syns: *Echinorhynchus* sp. Krefft, 1871
Corynosoma sp. Johnston & Deland, 1929
Corynosoma cetaceum Johnston & Best, 1942; Figueroa & Puga, 1990; Aznar et al, 1999
Polymorphus cetaceus Schmidt & Dailey, 1971
Polymorphus arctocephali Smales, 1986; Edmonds, 1989
Hosts: *Arctocephalus pusillus doriferus* (Schreber), SA, V, Smales 1986: 97-99; Aznar et al 1999: 59-70; AHC 13787, 14835, 23344, 33112, 32128, 32130, 32132, 32109, 32110, 43654-57
Delphinus delphis Linn.,* SA, V, Johnston & Deland 1929: 149; Johnston & Best 1942: 250; AHC 3418, 18883, 30157, 40963, 40964, 42266-71
Hydrurga leptonyx (Blainville), V (Zoo)
Leptonychotes weddelli (Lesson), Antarctic, AHC 18025
- Tursiops truncatus* (Montagu), SA, V, Johnston & Best 1942: 250; AHC 1778, 3602, 18362, 18678, 18743, 18949, 18951, 18970, 19646, 19950, 19952, 19959, 22831, 22838, 22839, 24757, 26198, 30111, 30144, 30145, 30156, 30328, 30331 30332, 32122-24, 32111, 32117, 32121, 32125, 32127, 42272, 42273
seal, Q (Zoo), QM G207090.
40. *Corynosoma pseudohammani* Zdzitowiecki, 1984
Syns: *Corynosoma antarcticum* Johnston & Best, 1937 *nec* *C. antarcticum* Rennie, 1906
Corynosoma hammani Edmonds, 1957b, possibly a mixed infection of *C. hammani* and *C. pseudohammani*, see Zdzitowiecki, 1984b
Corynosoma pseudohammani Zdzitowiecki, 1984b, 1986a, 1991; Hoberg, 1986
Hosts: *Leptonychotes weddelli* (Lesson),* Adelie Land, Enderby Land, Johnston & Best 1937:10-12; Edmonds 1957b: 96; AHC 18020, 42238, 42239, 42291-93, 42296, 42297, AM W2872
Hydrurga leptonyx Blainville, No locality data, AHC 42298, 42299.
41. *Corynosoma shakletoni* Zdzitowiecki, 1978
Host: *Pygoscelis papua* Forster, Macquarie Is., Edmonds 1955: 141; Zdzitowiecki 1985: 11; Hoberg 1986: 202; AHC 5067, CSIRO A38.
42. *Corynosoma stanleyi* Smales, 1986
Hosts: *Hydromys chrysogaster* Geoffroy,* Q, T, V, Smales 1986: 92-94; Smales & Cribb 1997: 449-450; AHC 8878, 15642, 15643, 15660, 18163, 18768, 22343, 27791, 27792, 30432, 43539, 43540.
43. *Polymorphus biziurae* Johnston & Edmonds, 1948
Nickol, Crompton & Searle, 1999 [Nickol et al comment generic assignment of *P. biziurae* is difficult because the putative intermediate host is a crustacean]
Hosts: *Biziura lobata* (Shaw),* NSW, SA, Johnston & Edmonds, 1948: 71-74; AHC 625, 3375, 3387, 3424, 5106, 7489, 19404, 42443-47, 424450-59
Cygnus atratus (Latham), SA, Mawson et al, 1986: 238; AHC 3391
Pelicanus conspicillatus Temminck, SA, Mawson et al 1986: 228
Phalacrocorax sulcirostris (Brandt), SA, AHC 3382, 42449

Phalacrocorax melanoleucos (Vieillot), SA, AHC 3384, 3389

Platalea flavipes Gould, SA, V, AHC 3388, 24061, 42455, 42457

Larus novaehollandiae Stephens, SA, AHC 3385

Threskiornis molucca (Latham), SA, T, AHC 3383, 3390, 5050, 13292, 42448, 42545, 42458.

44. *Polymorphus brevis* (Van Cleave, 1916)

Syn: *Arythmorhynchus brevis* Van Cleave, 1916b, 1945; Travassos, 1926; Golvan, 1960; Amin, 1985 as *A. brevis*

Polymorphus brevis Meyer, 1933; Amin, 1992

Host: *Botaurus poiciloptilus* Wagler, Q, QM GL11394, specimens missing from QM, identification could not be confirmed.

45. *Profilicollis sphaerocephalus* (Bremser, 1811)

Syns: *Echinorhynchus sphaerocephalus* Bremser, 1811 in Rudolphi, 1819; *E. haematopodis* Rudolphi, 1819; *E. lari* Rudolphi, 1819 see Yamaguti, 1963

Filicollis sphaerocephalus Travassos, 1926; Golvan, 1960

Polymorphus sphaerocephalus Van Cleave, 1947; Webster, 1948; Schmidt & Kuntz, 1967; Amin, 1992

Parafilicollis sphaerocephalus Petrochenko, 1958

Falsificollis sphaerocephalus Yamaguti, 1963

Profilicollis sphaerocephalus Khoklova, 1974; Golvan, 1994: 17; Nickol, Crompton & Searle, 1999

Hosts: *Bizuria lobata* (Shaw), SA, AHC 2988

Haematopus fuliginosus Gould, SA, AHC 5047, 18036, 18050 CSIRO A59

Haematopus sp., AHC 42307-14

Larus novaehollandiae Stephens, SA, T, AHC 296, 1873, 3364, 3372, 18049, 18210, 42305, 42306

Larus pacificus Latham, SA, CSIRO A58

Pelicanus conspicillatus Temmink, SA, AHC 3386

Phalacrocorax melanoleucos (Vieillot), SA, AHC 2662.

Rhadinorhynchidae

46. *Rhadinorhynchus johnstoni* Golvan, 1969

Rhadinorhynchus pristis Johnston & Edmonds, 1947

Rhadinorhynchus johnstoni Golvan, 1969

Accidental host: dolphin, NSW, Johnston & Edmonds 1947: 17; AHC 19948.

Species inquirenda

No specimens or further reference corresponding to these records can now be found.

1. *Echinorhynchus* sp.

Kreffft, 1871: 212; Johnston & Deland, 1929: 147

Host: *Delphinus forsteri* Gray; probably *D. delphis* Linn.

2. *Echinorhynchus* sp.

Johnston, 1912: 109; Johnston & Deland, 1929: 149

Host: *Eurystomus orientalis*

3. *Echinorhynchus* sp.

Johnston, 1910: 111; Johnston & Deland, 1929: 151

Host: *Phylidonyris novaehollandiae* (Latham) as *Meliornis novaehollandiae*

4. *Echinorhynchus* sp.

Johnston, 1910: 107; Cleland, 1922: 108

Host: *Psophodes olivaceus*

5. '*Echinorhynch*'

Cleland, 1922: 108

Host: *Myiagra inquieta* (Latham).

Acanthocephala

The following bird hosts are listed in Mawson et al 1986 as being infected with acanthocephalans but the material was listed as unidentifiable and has not been retained in any museum collection for further study.

Hosts: *Calidris ruficollis* (Pallas), *Coturnix ypsilophora* Bosc, *Egretta alba* Linn., *Entomyzon cyanotis* (Latham), *Falco longipennis* Swainson, *Hiraaetus morphnoides* Gould, *Hydroprogne caspia* (Pallas), *Macrorrectes giganteus* Gmelin, *Oxyura australis* Gould, *Peltohyas australis* Gould, *Platalea regia* Gould, *Rallus philipensis* Linn., *Sterna nereis* (Gould), *Tringa terek* (Latham), *Vanellus tricolor* (Vieillot).

HOST-PARASITE LIST

MAMMALIA

Eutheria

Muridae

<i>Hydromys chrysogaster</i>	<i>Corynosoma stanleyi</i>
water rat	<i>Plagiorhynchus cylindraceus</i>
<i>R. fuscipes</i>	<i>Porrorchis hydromuris</i>
bush rat	<i>Moniliformis moniliformis</i>
<i>R. norvegicus</i>	<i>Moniliformis moniliformis</i>
brown rat	
and as <i>E. rattus</i>	
<i>Rattus rattus</i>	<i>Moniliformis moniliformis</i>
black rat	
and as <i>Epimys rattus</i>	
<i>Rattus</i> sp.	<i>Moniliformis moniliformis</i>
rat	

Suidae

<i>Sus scrofa</i>	<i>Macranthorhynchus hirudinaceus</i>
pig	

Felidae

<i>Felis catus</i>	<i>Oncicola pomatostomi</i>
feral cat	<i>Porrorchis</i> sp.

Canidae

<i>Canis lupus dingo</i>	<i>Oncicola pomatostomi</i>
dingo	
as <i>C. familiaris dingo</i>	
<i>Vulpes vulpes</i>	<i>Plagiorhynchus cylindraceus</i>
fox	

Otariidae

<i>Arctocephalus forsteri</i>	<i>Bolbosoma capitatum</i>
New Zealand fur seal	<i>Corynosoma australe</i>
(in error as type host for <i>C. australe</i>)	
<i>A. pusillus</i>	<i>Andracantha clavata</i>
Australian fur seal	<i>Bolbosoma capitatum</i>
	<i>Bolbosoma vasculosum</i>
	<i>Corynosoma arctocephali</i>
	<i>Corynosoma australe</i>
	<i>Corynosoma cetaceum</i>
	<i>Corynosoma australe</i>
<i>A. tropicalis</i>	
sub-Antarctic fur seal	<i>Corynosoma australe</i>
<i>Arctocephalus</i> sp.	<i>Corynosoma australe</i>
<i>Neophoca cinerea</i>	
Australian sea lion	
<i>Phocartos hookeri</i>	<i>Corynosoma australe</i>
New Zealand sea lion	

Phocidea

Hydruga leptonyx
leopard seal

Leptonychotes weddellii
Weddell's seal

Mirouga leonina
southern sea elephant

Corynosoma australe
Corynosoma bullosum
Corynosoma cetaceum
Corynosoma pseudohammani
Corynosoma cetaceum
Corynosoma pseudohammani
Corynosoma bullosum

Ziphiidae

Mesoplodon bowdoini
Andrew's beaked whale

Mesoplodon layardii
strap toothed beaked whale

Bolbosoma vasculosum

Corynosoma australe

Balaenopteridae

Balaenoptera auctostrata
minke whale

Balaenoptera musculus
blue whale

Megaptera novaeangliae
humpbacked whale

as 'whale' possibly *Megaptera nodosa*

Bolbosoma balaenae

Bolbosoma capitatum

Bolbosoma turbinella

Bolbosoma balaenae

Bolbosoma balaenae

Delphinidae

Delphinus delphis
common dolphin

as *Delphinus forsteri*

Rhadinorhynchus johnstoni

Globiocephalus melas

long finned pilot whale

as *Globiocephalus melaena*

Globiocephala sp.

pilot whale

Pseudorca crassidens

false killer whale

Tursiops truncatus

bottle nosed dolphin

Corynosoma cetaceum

Echinorhynchus sp.

Bolbosoma balaenae

Bolbosoma capitatum

Bolbosoma capitatum

Corynosoma australe

Corynosoma cetaceum

Physeteridae

Physeter catodon
sperm whale

Bolbosoma capitatum

MARSUPIALIA**Dasyuridae**

Antechinus agilis
agile antechinus

Antechinus stuartii
brown antechinus

Australiformis semoni
Centrorhynchus bancrofti
Centrorhynchus sp.
Plagiorhynchus cylindraceus
Australiformis semoni
Centrorhynchus bancrofti
Plagiorhynchus sp.
Porrorchis hylae

<i>Antechinus swansonii</i> dusky antechinus	<i>Centrorhynchus bancrofti</i> <i>Centrorhynchus</i> sp. <i>Australiformis semoni</i>
<i>Phascogale tapoatafa</i> brush-tailed phascogale as <i>Phascogale penicillata</i> but may be <i>Bettongia penicillata</i>	<i>Centrorhynchus</i> sp. <i>Centrorhynchus</i> sp. <i>Plagiorhynchus cylindraceus</i> <i>Plagiorhynchus</i> sp.
<i>Sminthopsis leucopus</i> white-footed dunnart	
Peramelidae	
<i>Isoodon obesulus</i> southern brown bandicoot	<i>Australiformis semoni</i> <i>Plagiorhynchus cylindraceus</i> <i>Australiformis semoni</i> <i>Mediorhynchus</i> sp. larvae <i>Plagiorhynchus cylindraceus</i> <i>Plagiorhynchus</i> sp. <i>Australiformis semoni</i> <i>Plagiorhynchus cylindraceus</i> <i>Australiformis semoni</i>
<i>I. macrourus</i> northern brown bandicoot	<i>Australiformis semoni</i>
<i>P. gunnii</i> eastern barred bandicoot	
<i>Perameles nasuta</i> long-nosed bandicoot bandicoot	
Potorodidae	
<i>Potorous tridactylus</i> long-nosed potoroo	<i>Australiformis semoni</i> <i>Plagiorhynchus cylindraceus</i>
Notorictidae	
<i>Myrmecobius fasciatus</i> numbat	<i>Multisentis myrmecobius</i>
Macropodidae	
<i>Wallabia bicolor</i> swamp wallaby	<i>Plagiorhynchus cylindraceus</i>

AVES

Spheniscidae	
<i>Eudyptula minor</i> little penguin	<i>Andracantha clavata</i> <i>Corynosoma australe</i> <i>Corynosoma shakletoni</i>
<i>Pygoscelis papua</i> gentoo penguin	
Phalacrocoracidae	
<i>Leucocarbo atriceps</i> blue eyed cormorant as <i>Phalacrocorax atriceps</i>	<i>Andracantha clavata</i> <i>Corynosoma australe</i> <i>Andracantha</i> sp. <i>Andracantha clavata</i>
<i>Leucarbo colensoi</i> as <i>Phalacrocorax colensoi</i> Auckland Island shag	
<i>Leucarbo fuscescens</i> black faced shag as <i>Phalacrocorax fuscescens</i>	<i>Andracantha clavata</i>
<i>Phalacrocorax melanoleucos</i> little pied cormorant	<i>Andracantha clavata</i> <i>Polymorphus biziurae</i> <i>Profilicollis sphaerocephalus</i>

Phalacrocorax sulcirostris
 little black cormorant
 as *P. microcarbo*
Phalacrocorax varius
 pied cormorant
Phalacrocorax verrucosus
 Kerguelen shag
Phalacrocorax sp.

Andracantha clavata
Polymorphus biziurae
Centrorhynchus sp.
Andracantha clavata

Andracantha clavata

Andracantha clavata

Pelicanidae

Pelicanus conspicillatus
 Australian pelican

Polymorphus biziurae
Profilicollis sphaerocephalus

Procellariidae

Pactyptila turtur
 fairy prion

Plagiorhynchus charadrii

Ardeidae

Botaurus poicilopitus
 Australasian bittern
Nycticorax caledonicus
 rufous night heron 'egret'

Polymorphus brevis

Oncicola pomatostomi
Centrorhynchus sp. A

Plataleidae

Platalea flavipes
 yellow spoonbill
Threskiornis molucca
 sacred ibis
 as *Threskiornis aethiopica*

Polymorphus biziurae

Polymorphus biziurae

Plagiorhynchus cylindraceus

Accipitidae

Accipiter cirrocephalus
 collared sparrowhawk
Accipiter fasciatus
 brown goshawk
Accipiter novaehollandiae
 grey goshawk
 as *Astur novaehollandiae*
 and as *Astur cinereus*
Aviceda subcristata
 Pacific baza
 as *Baza subcristata*
Circius approximans
 swamp harrier
 hawk

Centrorhynchus asturinus

Centrorhynchus asturinus

Centrorhynchus asturinus

Centrorhynchus asturinus

Centrorhynchus asturinus

Centrorhynchus sp.

Turnicidae

Turnix castanota
 chestnut backed button quail
Turnix velox
 little button quail

Oncicola pomatostomi

Oncicola pomatostomi

Falconidae

Falco berigoria
 brown falcon

Centrorhynchus asturinus

Falco cenchroides
Australian kestrel

Centrorhynchus asturinus

Anatidae

Biziura lobata
musk duck
Cygnus atratus
black swan

Polymorphus biziurae
Profilicollis sphaerocephalus
Andracantha clavata
Polymorphus biziurae

Megapodiidae

Alectura lathamii
Australian brush turkey
and as *Catheturus lathamii*

Mediorhynchus alecturae

Rallidae

Gallinula tenebrosa
dusky moorhen

Plagiorhynchus cylindraceus

Pedionomidae

Pedionomus torquatus
plains wanderer

Oncicola pomatostomi

Haematopodidae

Haematopus fuliginosus
sooty oystercatcher
Haematopus longirostra
pied oystercatcher
Haematopus sp.

Plagiorhynchus charadrii
Plagiorhynchus charadrii
Profilicollis sphaerocephalus
Profilicollis sphaerocephalus

Glaucididae

Stiltia isabella
Australian pratincole

Mediorhynchus sp.

Burhinidae

Burhinus grallarius
bush thick-knee

Porrorchis hylae

Charadriidae

Chardris ruficapillus
red capped plover
as *C. alexandrinus*
Thinornis rubricollis
hooded plover
as *Charadrius rubricollis*
and *C. cuculatus* hooded dottrel
Vanellus miles
masked lapwing

Plagiorhynchus charadrii

Plagiorhynchus charadrii

Plagiorhynchus cylindraceus

Scolopacidae

Limosa laponica
bar-tailed godwit
Numenius madagascarensis
eastern curlew
as *Numenius cyanopus*

Arythmorhynchus limosae

Arythmorhynchus johnstoni

Laridae*Larus dominicanus*

kelp gull

Larus novaehollandiae

silver gull

Larus pacificus

Pacific gull

gull

*Corynosoma shakletoni**Polymorphus biziurae**Profilicollis sphaerocephalus**Profilicollis sphaerocephalus**Mediorhynchus* sp. B**Cuculidae***Centropus phasianus*

pheasant coucal

*Plagiorhynchus charadrii**Porrorchis hylae***Strigidae***Ninox boobook*

southern boobook

as *Ninox novaseelandia**Ninox strenua*

powerful owl

*Centrorhynchus bancrofti**Centrorhynchus bancrofti***Podargidae***Podargus strigoides*

tawny frogmouth

*Porrorchis hylae***Alcedinidae***Dacelo novaeguineae*

laughing kookaburra

Dacelo sp.*T. macleayii*

forest kingfisher

Todiramphus sanctus

sacred kingfisher

kingfisher

*Centrorhynchus horridus**Centrorhynchus horridus**Centrorhynchus horridus**Centrorhynchus horridus**Centrorhynchus* sp.**Campephagidae***Lalage leucomela*

varied triller

*Oncicola pomatostomi***Menuridae***Menura alberti*

Albert's lyrebird

Menura novaehollandiae

superb lyrebird

*Plagiorhynchus menurae**Plagiorhynchus menurae***Motacillidae***Anthus novaeseelandiae*

Richard's pipit

*Oncicola pomatostomi***Muspidae***Melanodryas cucullata*

hooded robin

Microeca leucophaea

jacky winter

Turdus merula

European blackbird

*Oncicola pomatostomi**Oncicola pomatostomi**Oncicola pomatostomi**Plagiorhynchus charadrii*

Zoothera dauma
white thrush
Zoothera lunulata
Bassian thrush
as *Oreocinclla lunulata*

Oncicola pomatostomi
Oncicola pomatostomi
Plagiorhynchus cylindraceus

Pachycephalidae

Colluricincla harmonica
grey shrike thrush
Oreoica gutturalis
crested bellbird
Pachycephala inornata
Gilbert's whistler
Pachycephala rufiventris
rufous whistler
Rhipidura leucophrys
willie wag tail

Oncicola pomatostomi
Mediorhynchus colluricinclae
Oncicola pomatostomi
Oncicola pomatostomi
Oncicola pomatostomi
Mediorhynchus colluricinclae

Orthonychidae

Cinclosoma castonotus
chestnut quail thrush
as *C. castaneum*
Cinclosoma cinomomeum
cinnamon quail thrush
Petroica goodenovii
red capped robin
Psophodes olivaceus
eastern whiplbird

Oncicola pomatostomi
Oncicola pomatostomi
Oncicola pomatostomi
Plagiorhynchus sp.

Pomatostomatidae

Pomatostomus halli
Hall's babbler
Pomatostomus ruficeps
chestnut crowned babbler
Pomatostomus superciliosus
white-browed babbler
Pomatostomus temporalis
grey crowned babbler
and as *P. rubeculus*

Oncicola pomatostomi
Oncicola pomatostomi
Mediorhynchus coluricinclae
Oncicola pomatostomi
Oncicola pomatostomi

Sylviidae

Megalurus timorensis
tawny grassbird

Plagiorhynchus cylindraceus

Plocidae

Poephila cincta
black throated finch

Oncicola pomatostomi

Meliphagidae

Acanthagenys rufogularis
spiny cheeked honeyeater
Acanthochoera carunculata
red wattle bird
Acanthochoera chrysoptera
brush wattle bird

Mediorhynchus sp. B
Oncicola pomatostomi
Mediorhynchus alecturae
Mediorhynchus colluricinclae

<i>Licheostomus plumulus</i> grey fronted honeyeater	<i>Oncicola pomatostomi</i>
<i>Licheostomus virescens</i> singing honeyeater	<i>Oncicola pomatostomi</i>
<i>Manorina flavigula</i> yellow throated miner	<i>Oncicola pomatostomi</i>
Sturnidae	
<i>Acridotheres tristis</i> common mynah	<i>Plagiorhynchus cylindraceus</i>
<i>Sturnus vulgaris</i> common starling	<i>Plagiorhynchus charadrii</i> <i>Plagiorhynchus cylindraceus</i>
Paradisaeidae	
<i>Ptiloris victoriae</i> Victoria's riflebird	<i>Plagiorhynchus</i> sp.
Maluridae	
<i>Amytornis purnelli</i> dusky grasswren	<i>Oncicola pomatostomi</i>
<i>Malurus cyaneus</i> superb fairy wren	<i>Oncicola pomatostomi</i>
Acanthizidae	
<i>Acanthiza chrysorrhoa</i> yellow rumped thornbill	<i>Oncicola pomatostomi</i>
<i>Aphelocephala leucopis</i> southern white face and as <i>Climacteris leucopsis</i>	<i>Oncicola pomatostomi</i>
<i>Serricornis brunneus</i> red throat as <i>Pyrhadaemus brunneus</i>	<i>Oncicola pomatostomi</i>
<i>Serricornis cautus</i> shy hylacola	<i>Oncicola pomatostomi</i>
<i>Serricornis fuliginosus</i> calamanthus	<i>Oncicola pomatostomi</i>
<i>Serricornis pyrrhopygius</i> chestnut rumped hyacola as <i>Hyacola pyrrhopygius</i> 'hylacola'	<i>Oncicola pomatostomi</i>
Neosittidae	
<i>Daphoenositta chrysoptera</i> varied sitella	<i>Oncicola pomatostomi</i>
Climacteridae	
<i>Climacteris affinis</i> white browed tree creeper	<i>Oncicola pomatostomi</i>
<i>C. melanura</i> black tailed tree creeper as <i>C. wellsi</i>	<i>Oncicola pomatostomi</i>
<i>C. picumnus</i> brown tree creeper	<i>Oncicola pomatostomi</i>
<i>Cormobates leucophaea</i> white throated tree creeper as <i>Climacteris leucophaea</i>	<i>Oncicola pomatostomi</i>

Corcoracidae

Corcorax melanoramphus
white winged chough

Mediorhynchus corcoracis

Grallinidae

Grallina cyanoleuca
Australian magpie-lark

Mediorhynchus robustus
Mediorhynchus corcoracis
Oncicola pomatostomi
Plagiorhynchus cylindraceus

Artamidae

Artamus cinereus
black faced wood swallow
Artamus superciliosus
white browed wood swallow

Oncicola pomatostomi
Oncicola pomatostomi

Cractidae

Gymnorhina tibicen
Australian magpie
Strepera versicolor
grey currawong

Oncicola pomatostomi
Plagiorhynchus cylindraceus
Oncicola pomatostomi

Corvidae

C. bennetti
little crow
Corvus coronoides
Australian raven
C. mellori
little raven
C. tasmanicus
forest raven
Corvus sp.

Mediorhynchus corcoracis
Mediorhynchus corcoracis
Plagiorhynchus cylindraceus
Mediorhynchus corcoracis
Mediorhynchus corcoracis
Mediorhynchus corcoracis

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TWENTIETH-CENTURY ABORIGINAL HARVESTING PRACTICES IN THE RURAL LANDSCAPE OF THE LOWER MURRAY, SOUTH AUSTRALIA

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Summary

Since European settlement, Aboriginal people living in rural areas of southern South Australia have had a unique relationship to the landscape, reflecting both pre-European indigenous traditions and post-European historical influences. Aboriginal hunting, fishing and gathering practices in the twentieth century were not relics of a pre-European past, but were derived from cultural forces that have produced a modern indigenous identity. The Lower Murray ethnographic data presented in this cultural geography study were collected mainly during the 1980s, supplemented with historical information concerning earlier periods.

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Since European settlement, Aboriginal people living in rural areas of southern South Australia have had a unique relation to the landscape, reflecting both pre-European indigenous traditions and post-European historical influences. Aboriginal hunting, fishing and gathering practices in the twentieth century were not relics of a pre-European past, but were derived from cultural forces that have produced a modern indigenous identity. The Lower Murray ethnographic data presented in this cultural geography study were collected mainly during the 1980s, supplemented with historical information concerning earlier periods.

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INTRODUCTION

The Aboriginal people living in the Lower Murray region during the twentieth century were not hunters, fishers and gatherers in terms of their total subsistence economy; nevertheless, they continued some hunting, fishing and gathering practices. This paper explores contemporary relationships that indigenous people have with a landscape that has been transformed into an environment dominated by agricultural and urban activities. Unlike some northern desert and subtropical areas of Australia, where Aboriginal subsistence economies persist in an altered form in relative isolation (Altman 1987; Meehan 1982), European-style economic development in the south conflicts more directly with Aboriginal land use. In the Lower Murray, Aboriginal people have interacted extensively with Europeans since the 1830s. In spite of this, a distinct indigenous identity has remained and developed throughout this period (Clarke 1994, 1995, 1996a, 1996b, 1998b, 1999a, 2001a, 2001b, 2001ms). When Europeans first arrived in the Lower Murray region in the late 1830s, the Aboriginal people living there were differentiated into numerous descent groups and several dialects. Due to an early population crash and the eventual relocation of survivors into mission and state-controlled

institutions in the late nineteenth century, the descendants formed a new cultural and social identity. Throughout the twentieth century, indigenous people with pre-European connections to the Lower Murray landscape have called themselves Ngarrindjeri.¹

The pre-European hunter and gatherer subsistence economy in the Lower Murray region is, in comparison to the rest of southern Australia, well documented. Clarke (1985a, 1985b, 1986a, 1986b, 1987, 1988, 1998a) and Cleland (1957, 1966) have studied the ethnobotany of the region. Berndt and Berndt (1993), Campbell (1934, 1939, 1943), Campbell et al (1946), Clarke (1999b, 2001a, 2002), Hemming (1989, 1991), Hemming and Jones (1989) and Luebbers (1978) have provided overviews of the pre-European material culture. The main focus in the current work is with twentieth-century Aboriginal practices in the Lower Murray, although when Ngarrindjeri people are concerned data is included from the Riverland agricultural district of South Australia. The paper stems from the author's museum work and doctoral research addressing how indigenous people relate to a modern rural and urban landscape. It provides a list of words recorded from the local variety of Aboriginal English spoken during the author's field study in the 1980s. This adds to studies by Foster et al (1998,

¹ In early sources, such as Taplin (1859–79, 1874, 1879), Ngarrindjeri is written as 'Narrinyeri'.

2003) and Clarke (2001ms) that investigate the historical origins of twentieth-century Aboriginal English spoken in southern South Australia. Maps showing places of significance to Lower Murray people are provided elsewhere (Clarke 1994, 1999a, 1999b).

HISTORICAL BACKGROUND

The Lower Murray cultural region covers that part of the Murray–Darling Basin south of the entrance of the Murray River into Lake Alexandrina, including the southern coast of

Fleurieu Peninsula, the area surrounding Lake Albert and the Coorong. It formerly had a relatively high population density, with an estimated 6,000 people living there (Brown 1918: 230–231; Clarke 1994: 57–63) prior to the first smallpox epidemic of the 1830s. After official European settlement at Encounter Bay in 1836, the Aboriginal population continued to decline, chiefly due to other introduced diseases and land alienation (Clarke 1994: chapter 6; 1995: 156, end note 1; Gale 1969; Smith 1980). The survivors gradually moved into European-controlled situations, such as pastoral stations, the Point McLeay Aboriginal Mission and fringe camps

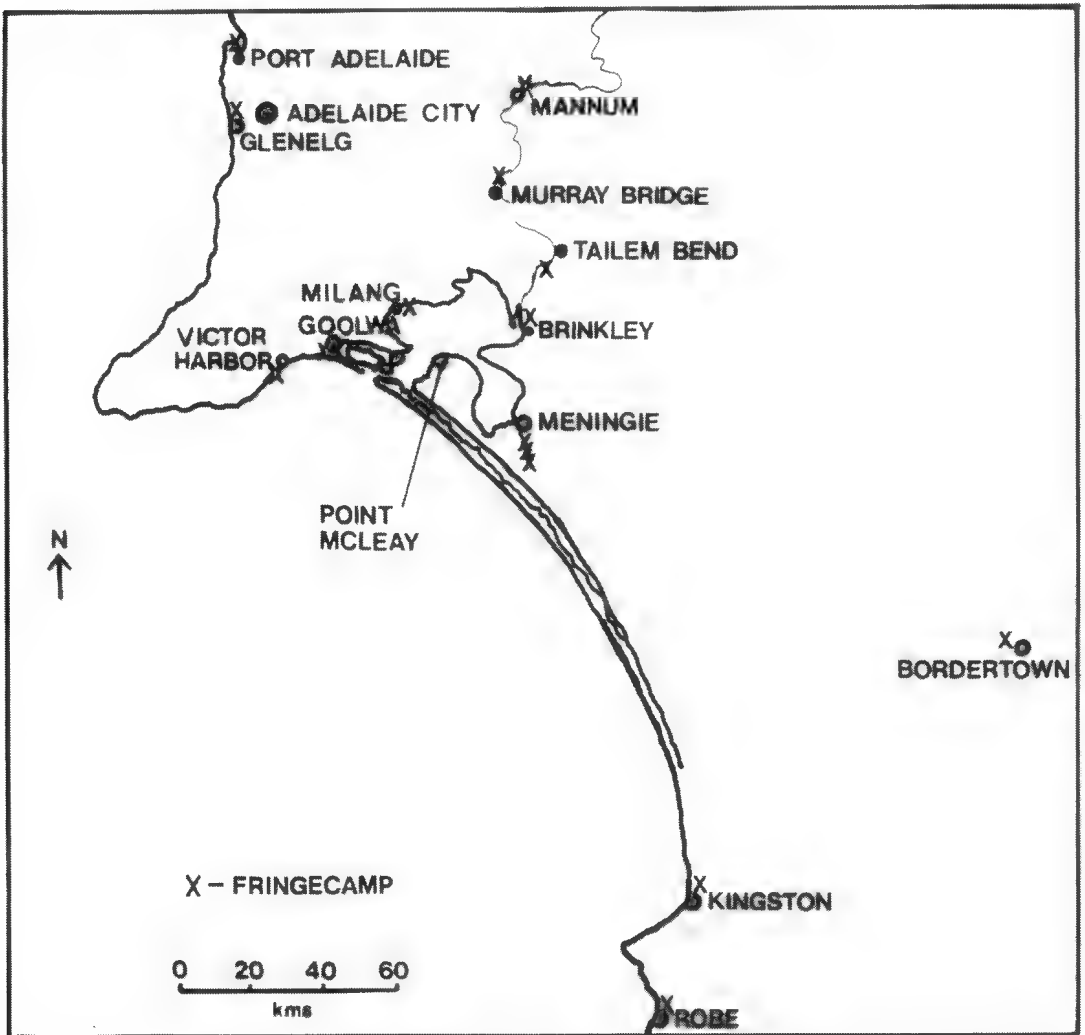


FIGURE 1. Twentieth century fringe campsites from Adelaide to the South East of South Australia.

around towns (Fig. 1).² Indigenous hunting, fishing and gathering activities declined as agricultural practices took over, commencing first in the northern section of the Lower Murray, restricting Aboriginal people to smaller parts of the landscape. Ngarrindjeri people worked in the whaling industry at Encounter Bay from 1836 (Clarke 2001a: 27–32). On the northern shore of Lake Alexandrina during the 1850s, Aboriginal people were drawn to living in towns, such as Milang and Wellington, due in part to their involvement in the fish trade (Taplin Journals, 12 April 1859). In 1859 the missionary George Taplin made plans to establish a fishing industry at Point McLeay, on the southern shore of Lake Alexandrina.³ This appears primarily to have been intended to make the local Aboriginal community more sedentary. Additionally, local hunting, fishing and gathering activities at this time would also have served to supplement the mission's poor supplies of food, the result of a shortage of capital.

By the end of the nineteenth century, the physical environment of the Lower Murray had deteriorated. Irrigation schemes up river, which commenced in 1881 at Monteith and spread to Loxton, Berri and Renmark, and across the border into Victoria and New South Wales, kept water levels low (Fenner 1931: 84; Griffin & McCaskill 1986: 22; Williams 1969: 84, 243–244; 1974: 49, 235–236, 240). This increased the saltiness of the lakes and also decreased natural fish stocks. The sea water entering Lake Alexandrina in 1901, due to abnormally low river levels, destroyed the lucrative wool washing industry that had been established at Point McLeay in the early 1880s (Jenkin 1979: 177–178, 206). In 1905 the Aboriginal fishing industry started by George Taplin ended due to competition with white fishers who had the funds to obtain better technology (Jenkin 1979: 211). The barrages at Hindmarsh Island to prevent sea water entering Lake Alexandrina were completed in 1940 (Linn 1988: 181; McCourt & Mincham 1987: 11). The authorities in charge of the Point McLeay

Aboriginal Mission at the time were in favour of their construction, as it promised them a more reliable supply of water suitable for agricultural purposes.⁴ However, an unfortunate consequence was that the barrages contributed to the siltation of the Coorong Lagoon, which also had a decrease in freshwater flow from the south due to the South East drainage schemes (Griffin & McCaskill 1986: 22; Holmes & Waterhouse 1983: 49–50; Jack Koolmatric cited Ely 1980).

The acquisition by the South Australian State Government of Narrung Station for subdivision into farming allotments occurred under the *Closer Settlement Act 1907* (Holtham, cited in Padman 1987: 10). The loss of this station as a whole was reported to be sorely felt by the Point McLeay people, who were previously allowed by the manager, George Hackett, to have free range over it for hunting, fishing and gathering (McCourt & Mincham 1987: 11). The Aborigines' Friends' Association, which administered Point McLeay from its base in Adelaide, responded to the planned subdivision by stating that 'it would be advisable to make the boundary between them [farmers] and the blacks as wide as possible'.⁵ Due to growing problems that the Association had with managing the mission, particularly with its increasing resident population, the government took it under direct control in 1916 as a mission station (Jenkin 1979: chapter 9). The Lower Murray could no longer support Aboriginal people in a totally pre-European fashion, involving seasonal movements across a range of ecological zones. This region had become part of 'rural South Australia'.

THE MODERN ENVIRONMENT

The Lower Murray has seen much economic development since European settlement (Clarke 1994; Fenner 1931; Griffin & McCaskill 1986; Linn 1988; McCourt & Mincham 1987; Williams 1974), due to factors such as the favourable climate of the region, the potential of the river for

² For instance, there were Aboriginal camps on Narrung and Paltaloch (pronounced by Aboriginal people as 'Portaluck') stations from the late nineteenth to early twentieth century. Aboriginal residents generally referred to the mission station as 'Raukkan' (or 'Ralkon'), which became an official settlement name in the early 1990s. Examples of fringe camps around towns were the Three Mile (from Tailem Bend) and One Mile (from Meningie).

³ There are many entries in Taplin's Journals concerning the establishment of the fishing industry. The important references are 21 September 1859, 18 October 1859, 25 November 1859, 22 December 1859, 11 January 1860, 7 February 1860, 15 February 1860, 1 March 1860. See also Jenkin (1979: 97–98, 110–111).

⁴ Memoranda to the Commissioner of Public Works from the Superintendent of Point McLeay and the Chief Protector of Aborigines (GRG 52/1, no.8/1930), State Records, Adelaide.

⁵ *Register* newspaper, 7 December 1906.

transport and irrigation, and the close proximity to Adelaide and the sea. Major highways and railway lines pass through the Lower Murray, connecting South Australia to the eastern states. Crops and pasture have largely replaced the indigenous vegetation. Irrigation directly from the lake and river system is common practice. It is difficult for the contemporary observer to imagine how the region appeared before European settlement. Only in locations marginal to agricultural use, such as the Younghusband Peninsula, do large tracts of indigenous flora remain. Aboriginal reserves and national parks on both sides of the Coorong Lagoon contain most of what remains of the pre-European landscape.

Many of the pre-European plants and animals formerly found in the Lower Murray are now either scarce or locally extinct (Tyler et al 1983). Those organisms that formerly occurred in open woodlands, grasslands and the river have suffered most. Such habitats were not only the first ecological zones exploited by European settlers, but are also the areas most intensively transformed by agriculture. In contrast, plants and animals found in the mallee or heavily wooded areas have generally fared much better.

Europeans have introduced many foreign plant and animal species into the Lower Murray. Not all of these were essential for farming. To create a neo-European landscape, South Australian colonists also introduced organisms as pets and garden plants (Rix 1978: 1–7). Other species came accidentally as weeds and pests. European-style agriculture favours the economic exploitation of a few species. Therefore, the biological diversity of farming regions is generally far less than for uncultivated land in the same area. European colonisation has irreversibly changed the ecosystem of the Lower Murray.

European intrusion into the Lower Murray has affected the distribution and abundance of most indigenous animal species, primarily due to the clearance of pre-European vegetation, the alteration of the water flow conditions and the introduction of exotic fish species into the basin. For instance, during the author's fieldwork in the 1980s many middle-aged and older Aboriginal people lamented the reduction in numbers of favoured species of eating fish, such as silver perch (*Bidyanus bidyanus*), golden perch (*Plectrophilus ambiguus*) and Murray cod (*Maccullochella peelii*). The once abundant Murray lobster (*Euastacus armatus*) is also now scarce in South Australia (Reschke 1985: 173–174; Warneke 2000: 104, 226). Several species of

water and ground birds became locally extinct (Eckert 2000b; Parker & Reid 1983). Mammals, in particular, have suffered immensely from European colonisation in the Lower Murray. For instance, the toolache wallaby (*Macropus greyii*), which featured in Lower Murray Aboriginal cosmology (Clarke 1997: 128), became extinct in the 1920s (Aitken 1983: 127; Robinson & Young 1983; Strahan 1983: 234).

The rural landscape of the Lower Murray created by Europeans provides refuge for many introduced species. A number of invertebrate pests have proliferated in the Lower Murray (Gross 1983; Zeidler 1983; Fisher 1983); for example, the introduced honey bee (*Apis mellifera*) is commonly encountered in all types of vegetation (Matthews 1976: 88), and has largely displaced indigenous bees, such as *Trigona* species, which were formerly a source of honey for southern Aboriginal people (Eyre 1845: 2: 273–274). Several foreign species of fish are established in the river and lake systems. In particular, the European carp (*Cyprinus carpio*), goldfish (*Carassius auratus*) and redfin perch (*Perca fluviatilis*) are replacing the pre-European fish fauna (Glover 1983; Sim et al 2000). Introduced birds, such as the house sparrow (*Passer domesticus*), feral pigeon (*Columba livia*) and starling (*Sturnus vulgaris*), predominate in the farm areas of the Lower Murray (Eckert 2000b). Foreign mammals, including the house mouse (*Mus musculus*), black rat (*Rattus rattus*), rabbit (*Oryctolagus cuniculus*), brown hare (*Lepus capensis*), feral cat (*Felis catus*) and fox (*Vulpes vulpes*), are living wild in the Lower Murray (Eckert 2000a). Domestic stock in the paddocks consists mainly of various breeds of cattle and sheep.

Some species of pre-European fauna have flourished under the altered ecological regime, whereas others persist in the reduced niches available to them. For instance, the stumpy-tailed lizard (*Tiliqua rugosa*) and the brown snake (*Pseudonaja textilis*) are favoured by the transformation of indigenous vegetation into pasture (Eckert 2000c: 92, 94; Thompson & Tyler 1983: 156). Field observations by the author during the 1980s suggest that species doing moderately well in certain areas are the echidna (*Tachyglossus aculeatus*) and water rat (*Hydromys chrysogaster*). Some animal species that became locally extinct in the Lower Lakes area have survived on the Younghusband Peninsula and in the Coorong National Park. These include the grey kangaroo (*Macropus fuliginosus*), brusher wallaby

(*Macropus rufogriseus*), emu (*Dromaius novaehollandiae*), wombat (*Vombatus ursinus*) and the mallee fowl (*Leipoa ocellata*). Wombats became locally extinct in the Lake Albert to Lake Alexandrina area by the late nineteenth century (McCourt & Mincham 1987: 10). Aboriginal sources in the 1980s claimed that the mallee fowl (native pheasant, *Leipoa ocellata*) disappeared in the Lower Lakes area during vegetation clearance in the early twentieth century.

The survival of these animals in the southern Coorong and parts of the adjacent South East of South Australia is the result of better coverage of pre-European vegetation. In the late twentieth century, some animal species spread back into the Lower Lakes area, presumably from surviving populations in the South East. For instance, grey kangaroos and emus reappeared on the Narrung Peninsula during the 1980s. Aiding this recovery was the existence of patches of indigenous mallee and sheoak scrub surviving on Aboriginal-leased land. Major causes of the loss of indigenous mammals were over-shooting and habitat destruction.

The plant species introduced by Europeans have had an irreversible effect on the Lower Murray landscape. In many areas weeds had reached equilibrium with the local vegetation by the 1980s. For example, the open areas on the sandhills of the Younghusband Peninsula were covered with the Mediterranean sea spurge (*Euphorbia paralias*) and marram grass (*Ammophila arenaria*), a dune-binding species from Europe.⁶ The bridal creeper (*Myrsiphyllum asparagoides*), a garden plant originally from South Africa, had taken over pockets of remnant scrub in the inland regions of limestone karst. Weeds dominated the farmed areas, particularly around Point McLeay. Nuisance species for farmers included the boxthorn (*Lycium ferocissimum*)⁷ from South Africa, evening primrose (*Oenothera stricta*)⁸ from America and horehound (*Marrubium vulgare*)⁹ from Europe, and many introduced grasses.

Rabbits have changed the structure of local

flora throughout southern Australia (Walker 1985: 84-5). Richard Penney introduced rabbits on some of the islands in Encounter Bay in 1841 (Whitelock 1985: 65), followed by mainland introductions of the rabbit in the 1870s (Rolls 1984). This has undoubtedly made some plant species, formerly used by Aboriginal people as food and medicine, locally extinct or rare. Rabbits also may have caused the displacement of many species of small mammal. A demonstration of the environmental impact of rabbits occurred in the 1950s when, due to a crash in the rabbit population through myxomatosis, there was significant regrowth of vegetation on the sand dunes of Younghusband Peninsula for a short period (McCourt & Mincham 1987: 19). The whole of the Lower Murray has become modified into a European landscape.

TWENTIETH-CENTURY HUNTING AND GATHERING PRACTICES

Although European settlement in the Lower Murray region occurred early by South Australian standards, some pre-European knowledge concerning the environment persisted in the Aboriginal community through the twentieth century. From the 1930s to the 1960s, researchers such as Harvey, Tindale and the Berndts recorded aspects of hunting, fishing and gathering practices from elderly people, such as Albert Karloan, Pinkie Mack and Clarence Long, who had maintained a 'memory culture' (Tonkinson 1993: xix).¹⁰ By the late twentieth century there were still some people in the Ngarrindjeri community who knew the identity and method of use of particular species of plants and animals, as well as the associated Aboriginal words (see Table 1). For example, in the 1980s an elderly Ngarrindjeri man remembered the term *yulinthun*, which referred to the actions of a hunter who swam out into a lagoon underwater and pulled ducks under by their feet.¹¹ As stated elsewhere, fieldwork with the Aboriginal population in the 1980s produced

⁶ Alcock & Symon (1977) give lists of Coorong plant species. Plant origins are given by Jessop & Toelken (1986).

⁷ Point McLeay Mission Station residents formerly ate the fruit (Wilson 1998: 42). In the 1980s some Aboriginal people would regularly shake boxthorn bushes growing in hedges, so that their fowls could eat the fallen fruits. Photographs (c. 1920) of boxthorn hedges are in the Ramsay-Smith collection, AA6, Anthropology Archives, S.A. Museum.

⁸ Primroses dominated the Lower Murray landscape to the extent that one of the Narrung farming properties near Point McLeay was called 'Primrose Farm'. Mission children ate the seeds (Wilson 1998: 28).

⁹ During the twentieth century Aboriginal people used horehound as a medicinal plant (Clarke 1987: 15).

¹⁰ Clarke (2002: 149-150) provides an overview of these ethnographic sources.

¹¹ A related Ramindjeri word appears to be *yori-un*, recorded as 'descending' or 'coming down' (Meyer 1843: 66).

TABLE 1. Fauna and flora terms used by Ngarrindjeri people in the 1980s

Species	Aboriginal term
Mammals	
cat (<i>Felis catus</i>)	malgu
dog (<i>Canis familiaris</i>)	booba, ke:li
echidna (<i>Tachyglossus aculeatus</i>)	porcupine
fox (<i>Vulpes vulpes</i>)	kanatji
horse (<i>Equus caballus</i>)	porthi
kangaroo, large (<i>Macropus</i> species)	primpari, marlu, wangami
mouse, house (<i>Mus musculus</i>)	punthi
possum (species?)	punmathi
rabbit (<i>Oryctolagus cuniculus</i>)	bappa
rat, water (<i>Hydromys chrysogaster</i>)	ra:wlkandi
sheep (<i>Ovis</i> species)	tjambaki
wombat, southern hairy-nosed (<i>Lasiorhinus latifrons</i>)	watu
Birds	
bird (all species)	pulyeri
chat, white-faced; tin-tack bird (<i>Ephthianura albifrons</i>)	nankinduli
coot, Eurasian (<i>Fulica atra</i>)	thuri
currawong, grey (<i>Strepera versicolor</i>)	kilindi, kilinglin
duck, black (<i>Anas superciliosa</i>)	mookari
duck, hardhead or white eyed (<i>Aythya australis</i>)	pungkari
duck, mountain (<i>Tadorna tadornoides</i>)	mounties
duck, musk (<i>Biziura lobata</i>)	tilmarri
emu (<i>Dromaius novaehollandiae</i>)	pamu
flycatcher, restless (<i>Myiagra inquieta</i>)	tjeri-tjeri
goose, Cape Barren (<i>Cereopsis novaehollandiae</i>)	lawri
gull, silver (<i>Larus novaehollandiae</i>)	thrukeri
hawk, brown (<i>Falco berigora</i>)	kiraki
hen, mallee (<i>Leipoa ocellata</i>)	lawan
heron, white-faced; crane, blue (<i>Ardea novaehollandiae</i>)	krawli
magpie, Australian (<i>Gymnorhina tibicen</i>)	multhari
mudlark; Murray magpie; piwi (<i>Grallina cyanoleuca</i>)	thil-thil
pelican (<i>Pelecanus conspicillatus</i>)	nori
plover, spur-winged (<i>Vanellus miles</i>)	ratha-rathi
raven (<i>Corvus</i> species)	maragani
shag, black; cormorant, black (<i>Phalacrocorax carbo</i>)	yoldi
skylark (<i>Alauda arvensis</i>)	thilbadi
snipe, little grey (species?)	kripari
stilt, banded (<i>Cladorhynchus leucocephalus</i>)	nilkani
swan, black (<i>Cygnus atratus</i>)	kungarri
tern, caspian (<i>Hydroprogne caspia</i>)	tenetjeri
wattlebird, red (<i>Anthochaera carunculata</i>)	rungran
willie wagtail (<i>Rhipidura leucophrys</i>)	ritjiruki
wren, superb blue (<i>Malurus cyaneus</i>)	watji(-bird)
Reptiles	
dragon, bearded (<i>Pogona barbata</i>)	gunap, wirrakothi
bluetongue lizard (<i>Tiliqua scincoides</i>)	pungkung
skink, drop-tail (order Scincidae)	kindi
sleepy lizard; stump-tailed lizard (<i>Trachydosaurus rugosus</i>)	galta, kalta, manthari
snake (all species)	krayi
tadpole (all species)	nyikunthi
tortoise	malanthaiperi
tortoise, turtle (all species)	thukabi

Species

Aboriginal term

Fish

bream, bony; pyberry fish; tukari fish (<i>Fluvialosa richardsoni</i>)	thukeri
callop; golden perch; yellowbelly (<i>Plectroplites ambiguus</i>)	callop, pilalki, pilaki
cod, Murray (<i>Maccullochella peeli</i>)	ponde
congolli fish (<i>Pseudaphritis urvilli</i>)	kungali
fish (all species)	marmi
mullet; yellow-eye (<i>Aldrichetta forsteri</i>)	kanmeri
mulloway; butterfish (<i>Argyrosomus hololepidotus</i>)	malawi
perch, silver; tcheri fish (<i>Bidyanus bidyanus</i>)	tjeri
porcupine fish (<i>Allomycterus pilatus</i>)	danimudla
tommy rough (<i>Arripis georgiana</i>)	pukaratji

Arthropods

ant (all species)	prildi
flea (order Siphonaptera)	titjeri
lice, of the head (<i>Pediculus humanus</i>)	gudlu, gudli, gooli, poti
lice, of the pubic region (<i>Phthirus pubis</i>)	mutharuk
wood-grub (species?)	waldaruk

Plants

apples, native; monterry (<i>Kunzea pomifera</i>)	manthri
ballart, coastal (<i>Exocarpos syrticolus</i>)	doll's eyes
box, white; Christmas-bush (<i>Bursaria spinosa</i>)	palgi
boxthorn (<i>Lycium ferocissimum</i>)	katheri(-bush)
bulrush; reedmace; flag (<i>Typha</i> species)	makuru, manangkri, manakeri
cherry, wild (<i>Exocarpos syrticolus</i>)	waltjeri (= wild cherry)
cranberry, native (<i>Astroloma humifusum</i>)	milbakorthi
currant, native (<i>Leucopogon parviflorus</i>)	kalathami, ngooli
date, wild (<i>Billardiera scandens</i>)	kundawi
flax-lily, pale (<i>Dianella longifolia</i>)	peentuk
fruit, edible sheoak (<i>Casuarina stricta</i>)	sheoak-apple
grass, basket making (unidentified species)	yalkeri
grasstree (<i>Xanthorrhoea</i> species)	kinyeri
grasstree flower stem when dried (<i>Xanthorrhoea</i> species)	ngleyi
gum, from wattle (<i>Acacia pycnantha</i>)	tangari
honeysuckle (<i>Banksia ornata</i>)	yelakut
juniper tree (<i>Myoporum insulare</i>)	boobialla, booalla, palberi
lignum bush (<i>Muehlenbeckia cunninghamii</i>)	watji(-bush)
old man's beard (<i>Clematis</i> species)	yalkuri
pea, broom bitter (<i>Daviesia genistifolia</i>)	kuranthantha
pigface (<i>Carpobrotus rossi</i>)	nganingi, poyup
root, edible species of (unidentified species)	mrangganyi, pakanu(-potato)
samphire (family Chenopodiaceae)	parragoni
sedge, coastal sword (<i>Lepidosperma gladiatum</i>)	ngrakani, thyuk, wingi
sedge, hoary rapier (<i>Lepidosperma canescens</i>)	pinki-moranyi
sedge, spiny-headed (<i>Cyperus gymnaulos</i>)	mangatu
sedge, sticky sword (<i>Lepidosperma viscidum</i>)	kukandu
sedges used to make baskets & mats	basket-rush
sow-thistle (<i>Sonchus oleraceus</i>)	thalgi
wattle, coastal (<i>Acacia longifolia sophorae</i>)	boobialla, booalla, kalari(-bush)

information on the pre-European mode of subsistence not previously recorded (Clarke 1986b). Many Ngarrindjeri people still used Aboriginal terms for fish species in preference to European names.

During 1980s fieldwork by the author, Aboriginal people usually brought forth information about plant and animal uses within the context of narratives of their own life history. For instance, many of the Aboriginal people interviewed about bush resources recalled what they, as children, had observed being collected and used by older kinsmen many years ago. Some remembered the types of food, such as fruits and berries, they gathered and ate on the way to and from school. Detailed accounts of the environment were received from Aboriginal people who had formerly relied on natural resources to supplement their meagre family income. Such people trapped water rats for their skins, fished, and caught rabbits for food and for sale. A variety of methods were employed. For water rats and rabbits, Aboriginal hunters used steel traps and wire snares. Opportunistic harvesting occurred too. For instance, Jack Koolmatrerie remembered that early in the twentieth century, Lower Murray people killed a beached 5.6 metre female whale near Rabbit Island in the Coorong Lagoon (Ely 1980). They dragged parts of it into their boat and later cut it up, distributing the meat among their neighbours at Point McLeay. On another occasion at Mypolonga, Koolmatrerie recalled that his father killed a large Murray cod with a double-barrel shotgun blast because he had no spear at hand.

The nature of Aboriginal lifestyles in the Lower Murray preserved some pre-European knowledge of environmental resources. At Point McLeay local sources of wild food helped families who were on rations. Ngarrindjeri woman Dulcie Wilson recalled that in the 1940s and 1950s:

Living by the lake, our diet consisted mainly of fish, bream, callup [golden perch], and cod. Rabbits also supplemented our diet. ... Sometimes, when father had shot a swan she [mother] would mince up the breast, mix it with herbs and onions and make delicious rissoles (Wilson 1998: 24).

From the time of the establishment of the Point McLeay Mission, Aboriginal family groups living there followed the practice of camping away from Point McLeay during the summer school break at places such as the Goolwa Channel, Ngalang (Gnurling Point), Mark Point and 'The Landing' near the Narrung Narrows.¹² All these summer camps were near inland waterways and were to some extent isolated from European settlements. It is likely that the earlier camps were formed around particular elderly family members who wanted to visit important cultural sites, such as seasonal camps and old burial grounds that were linked to their descent group. For Aboriginal people the camps served as a break from mission life, whilst for the mission authorities it probably eased the burden of providing food rations. Due to such seasonal movements, the Aboriginal population at Point McLeay during summer consisted mainly of the old and sick.

According to Lower Murray people interviewed in the 1980s, these annual trips continued until the mid 1960s.¹³ The people used 'wurley-sticks' and hessian sacks to make shelters, and took sugar, tea, flour for damper, jam and blankets.¹⁴ The main method of transport was by horse and buggy, although some people used dinghies too.¹⁵ Wild food, such as berries, cockles, fish, emus, echidnas, rabbits and kangaroos supplemented their provisions once they arrived and a pelican or swan wing served as a brush to sweep the floor of the shelter (Wilson 1998: 40). Extended family groups would stay away from the mission station for several weeks. The summer trips by families reportedly had the official support of the Point McLeay authorities. The school did not require the children during that time and the coastal environment was pleasant for camping out during the summer.

The Coorong as a destination was particularly attractive for a number of reasons. Up until the Second World War, non-Aboriginal farmers had largely ignored the margin of the Coorong Lagoon with its shallow soils and lack of water suitable for irrigation. The Coorong has several declared Aboriginal reserves along its mainland shore, some of them with small houses and shacks. In

¹² There are many early references to Coorong summer trips in Taplin's Journals (15 & 29 January 1862, 16 February 1862, 15 January 1863, 28 December 1864 – 3 January 1865).

¹³ Hemming (1994: 14) provides a photograph of a summer camp along the Coorong, in about 1900. More recent references are DETE (2001b: 81, 98) and Wilson (1998: 39–40, 97).

¹⁴ Temporary shelters made from bags were called *ngauwanthi*, shelter poles were called 'wurley-sticks', sugar was *pinyatawi* and tea was termed *lingali*. Elderly Ngarrindjeri people called damper *pampit*, although this term appears to be a Moandik word from the South East of South Australia (Clarke 2001ms).

¹⁵ Buggies were referred to as *tijeri* (flea), a reference to the reliance of a buggy when being drawn upon the body of a horse (Clarke 2001ms).

the 1990s Lindsay Wilson, who was an elderly Aboriginal man with ties to the Coorong and South East of South Australia, stated that Jacob Harris had taken him and other youths from Point McLeay to the Younghusband Peninsula during the 1930s.¹⁶ They took off all their clothes and lived by hunting, fishing and gathering. This was to 'introduce us to our country'.

In spite of the landscape changes by the early twentieth century, Aboriginal people in the Lower Murray retained a distinctly Aboriginal view and use of the physical environment, albeit in a modified form. Up until the 1930s some Aboriginal people, known in Aboriginal English as 'camp-blacks', lived in 'wurleys' (traditional shelters) on a hill overlooking the mission settlement. Some early traditional harvesting practices continued, particularly for people based in the fringe camps and living on reserves away from the mission. Some Ngarrindjeri people moved to other parts of South Australia to live and work. For example, the Giles family lived in the Riverland during the 1940s and 1950s by selling Murray cod when in season and water rat skins for the rest of the time. They lived in 'wurleys' made from introduced wild tobacco saplings and hessian bags, and by catching what food they could from around the camp:

We ate ducks and swans, and their eggs, fish, caught yabbies now and then, and there were plenty of rabbits around, especially during flood time. We would just grab them out of the lignum bushes, where they sat trying to escape the rising water (Grace 1990: 159).

Some of this wild food was traded with local farmers for clothes, tobacco, flour and milk. Bellchambers (1931: 120) reported that in the 1920s at Swan Reach in the Riverland, descendants from the local Aboriginal groups lived in fishing camps but suffered 'certain hardships from having no fishing facilities reserved for them.' This seemed strange to him, considering that the camp was almost permanent.

Aboriginal people worked on the periphery of many small-scale industries. For example, Ngarrindjeri people remembered catching baby long-necked tortoises (*Chelodonia longicollis*) and parrots in the Riverland as youths in the 1950s for the Adelaide pet trade. Leeches were collected and sold for use by Europeans to treat

various blood ailments (Clarke 1989: 3-4; Grace 1990: 171). Skinned and gutted rabbit carcasses were sold to cray fishermen for use as bait (Wilson 1998: 118). Aboriginal people also boiled sheep heads and lamb tails for food and collected loose 'dead wool' from paddocks for sale (Abdulla 1993).¹⁷ Short-term employment was gained from orchardists by fruit picking, from fishermen by cleaning fish, and from the farmers by stump and stone picking in the paddocks and hessian bag sewing (DETE 2001b: 59, 61, 69, 71). Non-Aboriginal people occasionally engaged in similar pursuits, but Aboriginal people living along the river relied on these activities to such an extent that it became a part of their rural lifestyle.

During more restrictive periods in the early twentieth century, such as when the 'colour bar' operated in the rural towns of the Lower Murray (Berndt & Berndt 1951; Clarke 1994: section 6.4), exclusion from many of the benefits gained through access to towns helped maintain a high level of interaction between Aboriginal people and the physical environment. In particular, it was apparent in the 1980s when interviewing Ngarrindjeri people that former dwellers of fringe camps had extensive knowledge of the medicines and edible plants that were 'used by the old people'. This was simply because they had needed these indigenous resources to survive. The proximity of their dwellings to main roads and settlements during the 1950s and 1960s did not lessen their connection with the broader environment. In the 1980s a few elderly people from this background still collected wild plants, such as sow thistle. The stems were eaten as food, described as 'blackfellow's salad', and the milky sap was used for treating cuts and warts (Clarke 1986a: 10; 1987: 9). Sow thistle was in a category referred to as 'blood medicine', because of its invigorating property as a food and tonic. When the 'colour bar' formally ceased to operate, allowing Aboriginal people much greater access to towns, the use of wild foods and building materials decreased markedly, since the wild resources of the landscape were no longer needed as a buffer between rations and wages. This had a detrimental impact upon the survival of Aboriginal knowledge of the pre-European uses of naturally occurring plants and animals.

The heavily regulated lifestyle of Aboriginal

¹⁶ Also reported by Wilson (1998: 89, 115).

¹⁷ Acrylic painting (S.A. Museum, A69498) by Ian Abdulla, 1990, features collecting dead wool in the Riverland agricultural district of South Australia.

people in the Lower Murray had helped to maintain some knowledge of traditional resource exploitation through hunting, fishing and gathering. Nevertheless, many of the former hunting and gathering places, particularly those in agricultural areas, were inaccessible to Ngarrindjeri people. By the mid 1960s, when legislation restricting Aboriginal movements was rescinded (McCorquodale 1987), visits by large family groups to summer camping sites, such as along the Coorong, declined in frequency. People now had other places they could go for recreation. The European-dominated landscape partially opened up for Aboriginal people, resulting in more movement into towns and the Adelaide suburbs. The summer trips, although recreational, had been important events that gave participants a sense of belonging to the Lower Murray landscape. Through the 1980s, the descendants of families that had lived on the Aboriginal reserves continued to maintain a connection with this area. Although based in Adelaide, some of them leased these reserves from the Aboriginal Lands Trust and maintained small holiday shacks on them.

In the 1980s older members of Aboriginal families that had taken up farming on various Lower Murray reserves generally had some knowledge about pre-European uses of plants and animals. This was so because of their earlier reliance on naturally occurring resources to supplement supplies gained from local towns and because they had an occupation that still involved use of the land. Fringe camp dwellers and Aboriginal farmers were marginal people in the sense that their greater remoteness from direct white control, in comparison to people 'on the mission', meant that they were unable to rely on outsiders for all their material requirements. These people therefore needed to be more opportunistic than those more directly supported by the state. Some Aboriginal people were able to move between the Aboriginal farms, the fringe camps and the mission station.

FISHING

Fishing was a major activity of Aboriginal people in the pre-European period (Clarke 2002), and continued after European settlement, with the involvement of Aboriginal people in the fishing industry. The seasonality of European-controlled fishing activities would have suited the incorporation of indigenous labour, particularly during the nineteenth century when Aboriginal

movements were less restricted. European fishers in the Lower Murray adopted the use of many Aboriginal fish names. The importation of these words into Australian English, like those for other faunal species with a restricted distribution, was generally confined to the area of the source language (Ramson 1966: 120–121; Turner 1972: 123). For example, the golden perch is also widely known in Australian English, particularly in the eastern states, as 'yellow-belly', based on its appearance. In the South Australian section of the Murray River, contemporary anglers call it 'callop', which is probably derived from an Aboriginal term, *kalapko*, from the Ngaiawung and Nganguruku languages of the Riverland district (Clarke 2001ms). Nevertheless, many non-indigenous fishers of the Lower Lakes still refer to this species as *tarki*, based on one of the associated Ngarrindjeri words (Clarke 2001ms; Eckert & Robinson 1990: 18–19; Smith 1930: 229; Turner 1972: 123). During the author's 1980s fieldwork, Lower Murray people exclusively used another Ngarrindjeri word, *pilalki*, for this fish.

In the 1860s involvement in the Lower Lakes fish trade centred at Milang was a major part of the economy of the Point McLeay Aboriginal Mission. The creation of the Murray River Barrages, completed in 1940, destroyed this mission station enterprise (Clarke 1994: section 6.1). In particular, the mulloway (*Argyrosomus hololepidotus*) and jumping mullet (*Liza argentea*) fisheries around the Murray Mouth and in the Coorong suffered (Olsen 1991: 2, 21–22; Sim et al 2000: 103, 105). Ngarrindjeri people also participated in the Murray River fishing industry (Abdulla 1993; Grace 1990). Oscar Kartinyeri recalled during an interview with the author in 1988 that Aboriginal people in the Lower Murray and upstream to the Riverland agricultural district of South Australia in the early twentieth century used handmade nets to catch fish. These nets were made from split rushes, scalded before knotting to strengthen them. The fish would be driven up creeks leading into the river and the net placed across the entrance. Fish were then forced back downstream into the net. Golden perch and silver perch were often caught in this manner. Apparently the Mannum to Renmark area of the Murray River had many such creeks suitable for this purpose. According to Jack Koolmatie, nets and fish-traps were still being utilised by Aboriginal people in the Coorong during the same period (Ely 1980). Bellchambers (1931: 21–22) claimed that along the Murray

River the Aboriginal fishing spear made from two lengths of fencing wire mounted on a wooden shaft was still commonly made in the 1880s and was the last pre-European style weapon to disappear from general use. The poorer examples he saw being made in the 1920s were for sale to European 'relic hunters'.

During the author's fieldwork, an Aboriginal person gave an account of how Aboriginal people living along the Murray River during the 1950s stored surpluses of fish. A Ngarrindjeri man and his family travelled to the Riverland to find seasonal work, such as fruit picking. Fish from the river, caught by the father, were a major source of food. The man was eventually offered a shearing job away from camp for a few days. Nevertheless, he did not want to leave his family without a means of getting food. Therefore, before leaving he fished, catching seven or eight fish for several meals. The surplus was kept in a nearby small muddy pond. The fish remained alive for several days, and were pulled out by his family as required. This man apparently often put fish there. This method of preserving food is similar to that for the fish storage ponds described in the early ethnographic literature (Clarke 2002). Near Pelican Point, European fishers also kept their fish alive by placing them in 'pounds' made of ti-tree stakes, while they waited for favourable weather to allow transportation to the Goolwa market (Evans 1991: 40). It is not known who learned this practice from whom.

Aboriginal people were opportunistic in some of their economic activities. For instance, from August to September a large number of bony bream (*Nematalosa erebi*) die of natural causes in Lake Alexandrina and Lake Albert, floating to the surface. Local Aboriginal people were once in the habit of going to the lakeshore or heading out in small boats to collect them. According to Ngarrindjeri sources, up until the 1930s and 1940s old women at the mission station would organise children into groups with hessian bags to collect the dying fish from the lake shore. The only fish taken were those with red gills, as this is a sign of their freshness. This species of fish has sweet flesh, although its numerous bones make it commercially less valuable.¹⁸ Many younger Aboriginal people refused to eat this fish, and still do, precisely because it is so bony. In the 1980s a

few of the older Lower Murray people were still able to cook the fish in such a way that the bones came away in one piece.

As a result of a decline in the Lower Lakes fishery, by the 1980s there were few Aboriginal people living at Point McLeay or in other Lower Murray towns who had any direct experience with commercial fishing. Whereas many older Aboriginal people could remember a time when favourite indigenous fish were abundant, by this time mainly European carp was caught. A few of the local non-Aboriginal people with fishing licences caught mainly estuarine fish, such as yellow-eye mullet (*Aldrichetta forsteri*) in the Coorong, and European carp (*Cyprinus carpio*), redfin perch and some golden perch in the Lower Lakes (Olsen 1990; Sim et al 2000). Aboriginal people who were middle aged or older, particularly women, were the main recreational fishers at Point McLeay. During fieldwork it was observed that several elderly women living there enjoyed fishing for silver perch and golden perch. A favourite location for them was at 'The Bulrushes', near Wangarawar Point on the northeastern edge of Point McLeay town reserve. Groups of old women, no longer burdened by child rearing, were in the habit of going fishing for long hours on the lake shore. Carp was the main fish species caught, but was generally left to die on the bank. Only a few of the Point McLeay residents would eat such coarse meat. Aboriginal people sometimes used it as yabbie bait (DETE 1998: 105). Parents and grandparents would occasionally take their younger children fishing along the lake or river. Youths also went fishing in the lagoons for carp with handmade thrusting spears.

During the author's Lower Murray fieldwork in the 1980s, most of the fishing by Aboriginal people was with hand-lines. Throughout southern South Australia, Aboriginal people often stated that they were reluctant to fish with rods. This is probably, to some extent, due to the inconvenience of carrying so much tackle.¹⁹ It was also said that the use of a fishing rod was 'too flash'. The hand-line tradition of fishing was an expression of the modern southern Aboriginal identity. Earlier in the twentieth century, Ngarrindjeri fishers often made their own lines from cord, with sinkers made from lead melted in

¹⁸ A version of the Ngurunderi story, told in schools, explains how this fish became bony (Education Department of South Australia 1988). In the Ngurunderi mythology, bony bream is the fish that young women are forbidden to eat (Berndt 1940: 173).

¹⁹ Aboriginal people in southern Australia, before the arrival of Europeans, probably did not commonly use the fishhook and line (Clarke 2002: 150–151).

a teaspoon (DETE 2001b: 82, 88). So strong was the hand-line practice in the 1980s that Aboriginal people consciously drew this distinction between themselves and white fishers. A young Aboriginal man explained that 'Only whitefellas use rods. Nungas [Aboriginal people] do it blackfella way.'²⁰

SHELLFISH GATHERING

Lower Murray people formerly collected shellfish in great numbers (Cann et al 1991; Luebbers 1978, 1981, 1982; Pretty et al 1983: 117–118; Tindale 1930–52: 67). The middens of mollusc shells frequently found along undisturbed sections of banks of the river and lakes, and on the shores of the Coorong and sea, provide evidence of this. Some Aboriginal people were employed by Europeans to collect cockles (pipi, *Plebidonax deltoides*) from along the Coorong beach in sugar bags (DETE 2001b: 88). By the late twentieth century, Aboriginal people largely ignored mussels (such as *Velesunio ambiguus*) and cockles as a food source, possibly due to environmental changes in the Lower Lakes making them either scarce or not as easily gathered. Up until the 1960s, when Aboriginal families visited Younghusband Peninsula and the Goolwa area during the summer, cockles and periwinkles were eaten (DETE 2001b: 64, 69, 70, 98). By the 1980s Lower Murray people rarely went there, apart from infrequent day visits. In spite of the proximity of Point McLeay to the sea, the modern landscape made it difficult for Aboriginal people to get to the ocean. Few Aboriginal people in the Lower Murray had access to watercraft or to the off-road vehicles needed to get to the beach via the Forty Two Mile and Ti-Tree Crossings. The contrast between the riverine and marine zones was made more apparent after the construction of the Murray Mouth Barrages, completed in 1940 (McCourt & Mincham 1987: 11).

During the 1930s and 1940s yabbies ('crawfish', *Cherax destructor*) were caught by Ngarrindjeri people in a small bay near Wangarawar, east of Point McLeay. There were two methods employed to catch yabbies: pumping their mud holes with one's foot, which forced the occupant out of a connecting tunnel; or fishing

for them with meat on a string (Wilson 1998: 92). Ngarrindjeri woman Jenny Grace recalled that as a child in the Riverland during the 1950s:

We'd be in the water a lot getting yabbies too. In the winter time we used to go and crawl in the swamp for yabbies. We'd feel under the blanket weed and we'd find them under there (Grace 1990: 166).

Yabbies were important, not just as food but also as bait for Murray cod fishing (Abdulla 1993). In the 1980s Lower Murray people caught yabbies, chiefly during visits to the Riverland, by using nets and wire traps.

MAMMAL HUNTING

By the early twentieth century, most of the traditional material culture and skills associated with Aboriginal hunting and fishing practices in southern South Australia had disappeared (Hemming 1991: 134; Sutton et al 1988: 186). Duck nets and spears had previously typified hunting and fishing in this region (Clarke 1994: section 4.2; Hemming & Jones 1989). In the case of Lower Murray clubs, a few types persisted. Men kept the fighting stick, or *kanarki*, as a weapon of defence in their wurleys and houses (Wilson 1998: 110). This was the custom as late as the 1940s, according to Aboriginal sources. Also, until about the 1960s, male youths were in the habit of using a short club, or *wadi* (waddy), with a single or double bulbous head to throw at rabbits (DETE 2001b: 82, 89; Wilson 1998: 39, 58). For them, the killing of rabbits was a game of skill, the thrower having to gauge the distance whilst aiming at the head. With the demise of wurley camps and the introduction of firearm restrictions, these 'old' style weapons have become souvenirs or museum pieces.

In the 1980s Ngarrindjeri people hunted rabbits and birds by shotgun or .22 rifle, chiefly as a recreational activity for the warmer months of the year. Lower Murray people could remember eating other creatures such as wood grubs, snakes, echidnas and a variety of lizards. Kangaroos were eaten less than introduced red meat sources like sheep, mainly due to their scarcity. In the decades prior to the 1980s, most kangaroo meat came from areas in the South East of South Australia, such as Coonalpyn or Kingston, where they were still

²⁰ Aboriginal people define Nungas (pronounced 'Namgars') as indigenous people from southern South Australian communities (Clarke 2001ms; Mattingley & Hampton 1988).

relatively common. Aboriginal men had earlier been involved in shooting kangaroos for their hides in the South East (Wilson 1998: 96). During the 1980s at Point McLeay, some people, originally from the West Coast of South Australia, would catch, cook and eat blue-tongue and sleepy lizards, which are relatively common on the Narrung Peninsula.

Ngarrindjeri family groups hunted water rats for their skins, which were sold to European furriers. During the early to mid twentieth century this appears to have been more commonly practised along the Murray River, from Tailem Bend to the Riverland. Ngarrindjeri woman Jenny Grace remembered how water rat hunting was a common activity during her childhood in the Nildottie area of the Murray River during the 1950s. On the family boat:

Most of the room would have been taken up with the boards, and I would have to sit on top of them. These boards were used for pegging out rat skins. ... We'd just travel around, maybe row about seven miles, camp near where there was a big swamp or something, where we thought it was going to be good for rats. I think dad had about 120 traps and they would have been the most valuable possessions that we had. ... We'd stay in one place for about three days usually, until the skins dried, and if we ran out of boards to peg them on we'd peg them onto the gumtrees then roll them up ready to be sold (Grace 1990: 158).

The skins were destined for the fur market in Adelaide. The families of Bluey Roberts and Jerry Mason junior were also involved in catching water rats in the Riverland (DETE 1998: 86; 2001b: 78). Colin Cook said that at one time they sold the water rat skins for about four shillings each (DETE 2001b: 62). Ian Abdulla, who lived at Cobdogla during the 1950s and 1960s, claimed that:

There was another way of making an income and that was catching rats and selling the skins to a buyer at Renmark in the Riverland so the skins could be used to make purses or handbags. To get the rats we had to dive down to the bottom of the creek or swamps to get mussels to put on the traps. ... We set the traps on logs to catch the rats overnight. ... The next morning my father and brother would go out in the boat to check the traps to see how many rats we caught overnight, then they would take the rats home to be skunt or skinned. Then the skins

were pegged out on the boards and put in the sun to dry (Abdulla 1993).²¹

In the 1980s Ngarrindjeri woman Laura Kartinyeri said that her family had been heavily involved in the water rat skin trade, particularly when they were based in the Three Mile Camp at Tailem Bend. Such activities fitted in with spells working as farm labourers or in local factories.

During the author's fieldwork, rabbits were the most readily obtained wild mammals in the Point McLeay region. Although most Aboriginal people knew that the rabbit was an introduced species, this did not diminish the cultural importance of rabbit shooting. On many occasions hunting parties were organised spontaneously, rather than in advance. A visitor who was unfamiliar with the region may have had one of these events arranged for their benefit. This allowed the Lower Murray people at Point McLeay to 'show our land' to the newcomer. Even when a hunting party was primarily a response to a desire for rabbit or duck meat, the cultural significance remained. A senior person in the community made arrangements for obtaining guns and a car. The type of car preferred was usually a large sedan with high clearance from the ground. Generally, the time chosen to go 'rabbiting' was the early evening when it was becoming dark. Hunting excursions were generally to nearby Aboriginal-run land reserves and farms, such as Block K, Gum Park, or in the paddocks at the back of Big Hill.

Local hunting trips were almost entirely male events. Women might be present when the shooting was secondary to another activity, such as getting firewood. On most trips experienced by the author, a particular old 'uncle' at Raukkan was consulted early during the arrangements. This was to see if he would come along, or whether he could lend some of his guns, or simply to tell him that people were 'going bush'. The driver was usually the organiser, because he took control of where the party went. The favoured areas for shooting had driving hazards which were difficult to see at night. Obstacles to avoid included fallen trees, tree stumps, low patches of scrub, sand drifts, rabbit warrens, piles of limestone, soakages, rusting farm machinery, barbed wire tangles and general rubbish. It was therefore necessary for the driver to have a high degree of localised geographic knowledge. Men who had worked on the Point McLeay properties took pride in identifying the landscape during the night's

²¹ See Abdulla (1993), Clarke (2001b, pl. 92) and Hemming & Clarke (1991: 14) for paintings of water rat hunting activities.

activities and were delighted when outsiders lost their sense of direction. Although the driver usually did little shooting, the structure of the event meant that his was a high prestige role. Youths who took part generally either spotted with the searchlight or acted as runners to collect and finish off the shot rabbits.

There was some resistance to shooting at animals other than rabbits, despite the fact that hares, foxes, a small number of kangaroos and deer were often seen.²² The stated reason was usually that they were either not common or simply that they were not 'doing the hunters any harm'. In this context, Aboriginal people articulated that feral animals were to some extent like them, which is outside 'white law'. The shooting parties of local non-indigenous farmers do not possess this sentiment. Although they engage in rabbit shooting for recreation, the structure of their activity generally reflects their personal economic interests in getting rid of pests.²³

For Aboriginal people the aim was to shoot rabbits through the head, as this was a discarded part of the carcass. A plastic garbage bag in the boot of the car held the shot rabbits until the conclusion of the shoot. The gutting took place in the field in front of the car's headlights, as this was a messy job. The removal of the entrails made this operation too dirty for home. Back at Point McLeay, the heads and lower legs of the rabbits were chopped off, using a hatchet or machete on a block of wood. On a good night there would be as many as 50 rabbits to skin and gut. If there were a large number of rabbits killed, the processed carcasses were held by the hide of their legs on a clothesline until the whole job was over. This prevented dogs from running off with them before the end of the job. Hungry dogs at the settlement quickly removed the refuse produced.

The rabbit meat was ready for cooking after it had been soaked overnight in water to remove some of the strong odour of the flesh peculiar to rabbits. Next morning, various senior people at Point McLeay received the carcasses that were wrapped first in layers of newspaper and finally plastic. Often, the biggest share went to the provider of the guns or ammunition, or to the owner of the vehicle. Although people in the Point McLeay settlement would often hear about

a hunting trip the next day, the specific details were generally not discussed outside the local Aboriginal group. Hunting on Aboriginal land occurred in an Aboriginal realm of activity that Point McLeay people preferred to keep to themselves.

BIRD SHOOTING

The main species of duck hunted by Point McLeay people in the late twentieth century were the grey teal (*Anas gibberifrons*) and the mountain duck (*Tadorna tadornoides*). According to Aboriginal sources, the hardhead duck (*Aythya australis*) was common in the Lower Lakes but seldom seen by the 1980s (Wilson 1998: 90). Other species formerly hunted for food by mission station residents include the banded stilt (*Cladorhynchus leucocephalus*), black swan (*Cygnus atratus*) and Cape Barren goose (*Cereopsis novaehollandiae*). In particular, cooked swan intestines were regarded as a great delicacy²⁴ and the Cape Barren goose was desired for Christmas roast. The pelican (*Pelecanus conspicillatus*) was often hunted for its feathers, which were used in making house ornaments (Clarke 1994: 290, 336; 1996a: 75; DETE 2001b: 70). The flesh of the pelican was said to be like the shag (*Leucocarbo fuscescens*), considered 'too fishy to eat' by most Aboriginal people in the Lower Murray during the 1980s. Nevertheless, a Ngarrindjeri man claimed that the breast of the pelican was like steak if properly prepared. The carcass needed hanging for a few days 'to get rid of the wild taste'. Bait for fishing sometimes came from the flesh of the silver gull (*Larus novaehollandiae*). The bird was caught by baited hook on nylon fishing line tied to a log or branch.

Duck shooting usually happened in the early morning. It involved more stealth than for rabbits; the shooters often crawled for some distance and then hid. For this reason, bird-shooting groups from Point McLeay were generally smaller than those for rabbits. After travelling to the area in a car, the hunters walked to the lagoon. Talking outside the vehicle was minimal and in whispers. Messages were by hand signals and single word utterances in Ngarrindjeri language, such as *nakan*

²² The deer originally escaped in the 1980s from a stud near Narrung. The stud was then closed and the remaining stock removed.

²³ Morton (1990) has investigated the cultural role of non-Aboriginal hunting in contemporary Australia.

²⁴ Swan intestines were called *kungari waltjeri*.

('look'), *kungen* ('listen'), *tawul* ('stop') and *lewin* ('lie down'). As for rabbit shooting, knowledge of the landscape was crucial for duck shooting, not just to avoid obstacles but also to find a suitable place from which to shoot.

The main duck hunting sites near Point McLeay were the lagoons at 'The Bulrushes' and on the flats behind 'Big Hill' near Teringie. At the latter site the lagoons were periodically flooded. Point McLeay workers deliberately opened up the entrance to the lake with a tractor to produce a habitat to attract water birds. Bunkers were dug out of the mud well in advance of the hunting trip and the walls were covered with samphires (*Halosarcia* species). These served as shooting points next to lagoons, and were particularly necessary near Teringie where the landscape is open. Another spot at the Teringie lagoons from which to shoot was next to some large boxthorns. This area was 'prildi place' to some – a reference to the numerous ants found there at night. By crouching in front of the bushes, a shooter wearing dark clothing remained hidden from the birds. At 'The Bulrushes' there were plenty of hiding places among the lignum (*Muehlenbeckia cunninghamii*) and bulrushes (*Typha* species). The remains of an old limestone-walled bunker on the more open side of 'The Bulrushes' lagoon were still visible during the 1980s.

From a good early morning hunt, a dozen ducks might be shot. Birds were plucked on site before returning home to avoid making a mess in the township. Also, feathers lying about a person's yard may lead to unwanted questions from visitors from outside their extended community. There was some distrust of the authorities interfering with their activities. Back at Point McLeay, as with rabbits, senior people in the community tended to be given most of the catch.

COLLECTING BIRD EGGS

The practice of collecting swan eggs, known in Aboriginal English as 'swan-egging', was a major activity for Aboriginal people in the Lower Lakes and Murray River districts up until the late twentieth century (Abdulla 1993; DETE 2001b: 69; Ely 1980). Swan eggs (*kungari ngatjeri*) are large and greenish white; they are equivalent in volume to five average fowl eggs. Although they taste much the same as fowl eggs, those of the

swan are richer. The eating of a whole egg by a single person has been known to cause diarrhoea.

The persistence of bird egg collecting as a seasonal activity had continuity with pre-European harvesting practices. Aboriginal informants described how they would carefully observe swan behaviour from late winter. Although the swan-breeding season is broad and variable, Aboriginal people claimed that in the Lower Murray it occurred when the water levels in the lagoons were high. The men first tried to determine the general area where floating nests made from reeds were being built. To find the exact location, the collectors searched for swan tracks pushed through the bulrush beds. Collectors generally obtained the eggs by wading out into the lagoons, although occasionally small boats were used. Putting eggs in water tested their freshness – the ones that sank were considered good for eating. A few older Lower Murray people preferred to cook and eat eggs that had 'turned', meaning that they had chicks in them about to hatch. Swan-egging occurred mainly in spring, before tiger snakes (*Notechis ater*) become a major hazard in the warmer months.

Aboriginal people travelled long distances to obtain swan eggs. In the early twentieth century, men from the Point McLeay Mission Station used blanket sails on their dinghies to travel across the lake to Point Sturt, returning with hundreds of swan eggs (Wilson 1998: 44). As late as the 1950s, two women from Point McLeay rowed across Lake Alexandrina to Mulgundawa to obtain swan eggs in early spring (Padman 1987: 24). They returned with their dinghy so heavily laden with swan eggs that it was reported that only about 75 millimetres of the boat was above water. Certain Europeans in the Narrung area reportedly received some of the booty as a gift. Other Ngarrindjeri people used to row up Currency Creek in the southern Fleurieu Peninsula to collect swan eggs (DETE 2001b: 87).

European naturalists did not look favourably upon the taking of swan eggs. Inspector McIntosh of the Fisheries Department, before the First World War, recorded that at Tanunda Bay along the Coorong 'two half-castes had arrived with a boatload of swans' eggs, which system of wholesale robbery in the closed season the inspector understands is a common practice around the lakes'.²⁵ The ornithologist Captain SA White recorded his views in his account of a bird

²⁵ *Register* newspaper, 2 November [year not recorded] (Cutting Book, Anthropology Archives, S.A. Museum).

watching party he led to Dodd Creek on the western side of Lake Albert. He reports:

We intended to continue our observations among the water birds here, but to our disgust, we found a party of natives encamped. They trade under the name of aborigine, but most of them have very fair skins - in fact, quite white, as I remarked before. These men destroy a fearful number of swans, by rifling the nests. This outrageous slaughter should be stopped (White 1913: 57).

The scientific concerns of White and his colleagues were not compatible with the needs of local Aboriginal people.

Aboriginal people had to collect swan eggs by stealth. A farmer living near the Point McLeay settlement provided one account of a swan expedition from Point McLeay. She said:

Only a few years ago, the alarm was sounded all along the lake edge that four 'boys' from Point McLeay were missing. They had gambled that they could get some swan eggs although they knew that it was illegal. Those of us who lived along the waterway switched on lights in case the missing boys needed land marks. Some of the men were in the act of rigging up spotlights on four wheel drive vehicles when the call came that they were safe. Actually they'd been sitting behind some reeds for some considerable time, afraid to land, as they could see a police patrol vehicle at the ferry. Eventually they threw their forty odd eggs overboard, wrongly thinking that the officer was waiting to catch them (Padman 1987, p.25).

Since the 1980s Aboriginal people were legally able to remove the eggs in a restricted number of places, as long as it was not part of a commercial venture (Wilson et al 1992: 91-2). Nevertheless, as with rabbit and duck hunting, they tended to keep secret the details of these activities.

During the 1980s Lower Murray people generally ignored the eggs of birds other than the swan. Nevertheless, Ngarrindjeri informants say that in the 1940s and 1950s eggs of the silver gull were often obtained for eating. Collecting took place from islands in the Coorong. In particular, people living on nearby Aboriginal reserves on the mainland side had access to these resources. Other species whose eggs were eaten include the coot (*Fulica atra*), water hen (*Porphyrion porphyrio*), teal (*Anas gracilis*) and black duck

(*Anas superciliosa*) (DETE 2001b: 62, 64, 78-79, 94). Aboriginal people in South Australia had the right to take wildfowl eggs until this right was repealed under the *National Parks and Wildlife Act 1972*.²⁶ Under the *Fauna Conservation Act 1964* that it replaced, Aboriginal people had the right to hunt out of season, on crown land and on private property. In the latter case, hunting was allowed only if the landowner gave permission. In the 1972 Act no consideration was given to Aboriginal land use. Most Ngarrindjeri people spoken to in the 1980s asserted that they had the moral and cultural right to take a few swan eggs, as long as at least one egg per nest was left untouched. Aboriginal people claimed that swans would generally only rear one chick, and they therefore thought it was reasonable to leave only a single egg to become an adult. In the Lower Murray region Aboriginal gatherers stated that there are generally four eggs in each clutch.²⁷

ARTEFACT MANUFACTURE AND ART

Aboriginal people in the Lower Murray during the 1980s considered that the knowledge of how to make 'old time' artefacts, and of where in the landscape to obtain the necessary raw materials, helped to reinforce their Ngarrindjeri identity. After a long period, when Aboriginal woodcarving and art practices had largely vanished from the Lower Murray, these traditions were revived in the early 1980s. Some artefacts, described as 'old time' examples, were made for Aboriginal use as home decorations (Clarke 1996a). Some were also sold to non-Aboriginal collectors and museums. In these cases the objects were essentially statements of the artists' connections with the pre-European past. Artefacts such as baskets and mats were utility articles in the pre-European period, but from the 1980s they had the added status of icons, particularly for local Aboriginal people.²⁸ The interest in and consumption of Aboriginal culture by such non-Aboriginal agencies as contemporary art and artefact collectors, museums (Hemming & Jones 1989), and education departments (Education Department of South Australia 1988, 1990, 1991) has helped increase the significance of these items as symbols of a hunter-gatherer past.

²⁶ McCorquodale (1987) discussed the impact of legislation on Aboriginal issues.

²⁷ Ornithologists state the number of eggs in one clutch is between four and seven, although over ten has been recorded (Beruldsen 1980: 161). Breeding time is dependent upon water level.

²⁸ This trend grew through the 1990s, providing a medium for some indigenous people to express their cultural identity (see Bell 1998: 78-89).



FIGURE 2. Lindsay Wilson at the Coorong making a *wadi* club from eucalyptus wood, using a broken plate as a scraper.

Since the 1980s and early 1990s, Lower Murray artists and crafts people have had prominence in the local Aboriginal art and craft market in Adelaide (Hemming & Clarke 1991: 12–14; Sutton et al 1988: 188–190). Aboriginal people such as Paul Kropinyeri and Bluey Roberts specialised in carving. For example, Paul Kropinyeri experimented with making bark spear-deflecting shields, some of which the South Australian Museum purchased (Hemming 1991: 135–6; Sutton et al 1988: Fig. 230). One of his last projects was discovering how to make bark canoes. Bluey Roberts carved mainly emu eggs and boomerangs for sale as art pieces, developing a unique style that incorporated figural elements from both the West Coast side of his family, such as emus and goannas, and the Lower Murray side, usually a Murray cod (DETE 1998: 86–7; Hemming & Clarke 1991: 14; Sutton et al 1988: Fig. 234). As with Paul Kropinyeri, Lindsay Wilson used museum collections as a source of information for reproducing the old style weapons from the Lower Murray. Nevertheless, he was also able to draw upon his own memories of early boomerang and club types (Fig. 2). In the 1930s Lindsay Wilson had assisted Clarence Long in making clubs for sale to Europeans.²⁹ From the 1980s there was a small market in making realistic representations of pre-European harvesting and fighting implements.

Some artists expressed a close relationship to the landscape, not through making pre-European style objects, but by producing images in Western style art media. For example, Harvey Karpany produced water colour paintings and ink drawings that focused on various Lower Murray spirits and their associated environments (Hemming & Clarke 1991: 14; Sutton et al 1988: Fig. 236). Many Aboriginal people found that his work had a supernatural quality, being 'like *gupas*' (or ghosts). Jack Stengle concentrated on acrylic paintings on board and canvas. He tended to use Lower Murray mythology and history as subjects (Clarke 2001b: pl. 93; DETE 1998: 90–91, 2001a; Sutton 1988: Fig. 237). Older Aboriginal people in the Lower Murray community have played a major role as sources of the cultural and social data depicted in the work of these artists.

The local market for baskets was strong early in the twentieth century when similar 'third world' goods from India and Indonesia were not widely available. In 1909 the Royal Institute for the Blind attempted to get Aboriginal people at Point McLeay to make particular styles of basket to replace the rattan imports from Asia (Jenkin 1979: 214). The reluctance of Aboriginal people to change craft styles is reported to have led to the failure of this initiative. The Point McLeay Mission Station supported the basket-making tradition by placing it on the school curriculum in 1904 (Jenkin 1979: 227). The skill was taught to girls as part of their domestic duties (Wilson 1998: 23). Up until 1951 tourists on paddle steamers came across the lake to visit the mission. Dulcie Wilson recalled that 'Near to the jetty, women from the Mission would display their craft-work, mainly baskets and mats, made from rushes or grasses grown by the lake shore' (Wilson 1998: 25).³⁰ Basket and mat makers also sold their product to local non-Aboriginal people, before foreign imports from the 1960s priced them out of the market for cheap domestic items. The persistence of indigenous basket-making practices in the Lower Murray was primarily due to continued household use of these items by both Aboriginal and non-Aboriginal people.

In the early 1980s Lower Murray people revived their basketry traditions as part of the building of a local indigenous identity (Fig. 3). Due to the small but steady craft market that developed, this aspect of pre-European material culture has survived in a modified form to the present. Through the 1980s and 1990s the main Aboriginal people making mats and baskets were Ellen Trevorrow and Yvonne Koolmatrice, both of whom were taught the techniques by Dorothy Kartinyeri in 1982 (Clarke 2001b: 111–112; DETE 1998: 104–105, 110–111; Hemming 1989: 48; Sutton et al 1988: 187–188). Museums and art galleries have acquired examples of their work.

The making of flower ornaments from pelican feathers was another distinctive Lower Murray craft of the late twentieth century, although originally introduced from Victoria (Inglis 1961).³¹ Women chiefly made these to sell to visitors to the mission station, local farmers and

²⁹ Clarence Long, also known as Milerum, was considered by Tindale to be the last of the Coorong people with traditional knowledge of the Tangani people of the Coorong (see Tindale 1986: 498–499).

³⁰ Aboriginal informants remembered, as children, jumping into the lake for coins thrown from the paddle steamers. Trips from Goolwa ended in 1951 when the local steamer was destroyed in a fire (F. Tuckwell, pers. comm.).

³¹ Annie ('Fof-fon') Rankine was reputed to have been the first maker of feather flowers in the Lower Murray (J. Chilman, pers. comm.). She experimented with feathers from a number of species before concentrating on pelicans.

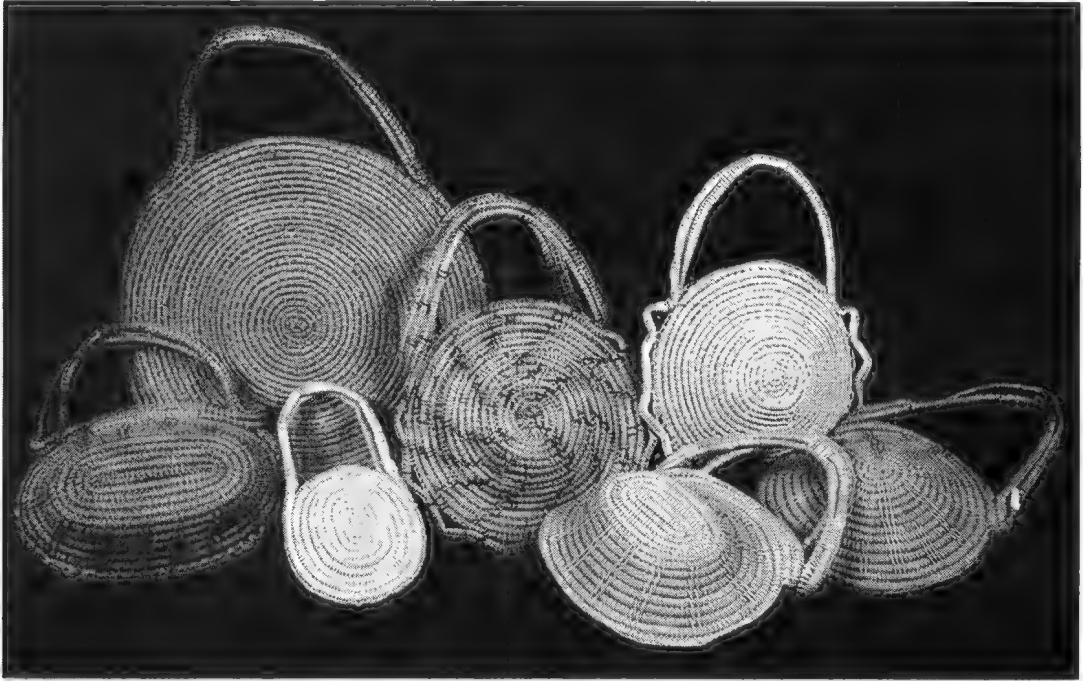


FIGURE 3. A selection of Lower Murray / South East 'sister' baskets. From top left: maker unknown, Mannum, c.1932 (A17530); Ethel Watson, Kingston South East, c.1931 (A15950); Yvonne Koolmatrie, Berri, 1989 (A69209). From bottom left: maker unknown, Manunka, c.1932 (A17524); Ellen Trevorror, Meningie, 1987 (A65184); maker unknown, Manunka, c.1932 (A16638), maker unknown, Encounter Bay, c.1900 (A2519).

town dwellers (Wilson 1998: 25). In the 1980s the National Parks and Wildlife Service would give permission for Aboriginal people to kill a pelican for its feathers. However, this was only in order to keep the tradition going because, legally, the finished artefacts could not be sold (Wilson et al 1992: 91-2). Aboriginal people occasionally used feathers from a pelican found dead, perhaps killed by the power lines. Alternatively, some people made their flowers from the feathers of bantams and other bird species.

As with other regions of Australia, the sale of artefacts supplemented the income of some extended Aboriginal families. Aboriginal people often earned money by demonstrating their unique craft and art styles to school children and special interest groups. In the 1980s the work of many southern Aboriginal artefact-makers and artists was being promoted through exhibitions and workshops organised by the South Australian Museum and the National Aboriginal Cultural Institute at Tandanya in Adelaide. In the case of the craft people, the knowledge of where to find

the raw material in the landscape and the possession of the appropriate 'traditional' artefact-making skills, was considered by them to be an integral part of their Lower Murray culture.

CULTURAL IMPORTANCE OF MODERN HUNTING AND GATHERING

Hunting and gathering wild food seasonally added to the food supply of many Aboriginal households in the Lower Murray, although its significance diminished in the closing decades of the twentieth century. As demonstrated by Sackett (1979) in the Western Desert, in assessing the importance of foraging activities to the contemporary community, it is wrong to assume that they were simply food-producing activities conducted solely in response to economic and recreational needs. For many Aboriginal people in the Lower Murray, foraging is an expression of their local identity. Hunting and gathering practices have important cultural values, not only

'proving' Aboriginal abilities in obtaining a living from the land, but demonstrating that people have an affinity with and knowledge of the landscape, however altered it is by non-Aboriginal activities. In the 1980s some Ngarrindjeri people associated their families with the totemic symbols (*ngatji*) of the pre-European clans.³² Most of these are birds, such as the musk duck (*Biziura lobata*), Cape Barren goose, pelican and black swan (Clarke 2001ms). Although these symbols no longer have a role in determining kinship relationships, the knowledge of them serves to reinforce Ngarrindjeri identity. Birds can have a modern symbolic significance as well. In the 1980s Aboriginal people in the Lower Murray adopted the black swan as the Ngarrindjeri emblem, as used, for example, on sporting uniforms.

Modern harvesting practices reinforce an Aboriginal view of the landscape, albeit a recently developed one. An analysis confined to the technology used, often steel traps and shot guns, would not adequately demonstrate the distinctiveness of Aboriginal use of the environment. The cultural importance of harvesting to Lower Murray people is particularly evident in the case of rabbit shooting. One of the advantages of this particular type of hunting is that it is a group activity. The use of a vehicle facilitates much conversation amongst the hunting party. Discussions concern the location of particular geographical features on the reserves, such as water tanks, ruins, old wells, trees, tracks and fences. The dialogue often touches upon past events associated with the scrub and the connecting farmland. Stories are told featuring the past residents of Point McLeay, as well as drawing upon the psychic realm of ghosts, spirit beings and sorcerers.³³ Although, to a lesser extent, this occurs during duck shooting and swan eggging, the high level of interaction among the hunters in vehicles is not possible when stalking or ambushing. Sometimes the most in-depth look at the land came when the group, or a part of it, later reflected upon the hunting trip. In their Aboriginal view of the landscape, the harvesting areas are topographically and culturally important sites. Aboriginal participants in shooting parties and

swan eggging expeditions not only forage for food; they are taking part in occasions for interpreting and experiencing their landscape.

Legislation in the twentieth century, restricting the killing of indigenous birds and prohibiting the taking of their eggs, severely affected Aboriginal bird harvesting practices in the Lower Murray. Although most Aboriginal people interviewed in the 1980s stated that hunters must leave certain species alone due to their scarcity, they perceived the wildlife protection acts as yet another encumbrance placed upon them by white authorities. Added to this were the restrictions placed on vehicular access to the Younghusband Peninsula. When speaking about land use, Lower Murray people stressed that they must be given the rights to continue pre-European-style harvesting practices. Aboriginal people saw no problem with national parks as long as they had access to their resources. During the 1980s local park and wildlife protection authorities allowed some degree of use of the parks for gathering raw plant materials for artefacts and for the shooting of protected faunal species. Some Ngarrindjeri men were employed as park rangers, which facilitated an improved relationship between the local Aboriginal community and the authorities. Nevertheless, the constant monitoring demanded by these activities, such as the individual permits required to shoot a certain number of animals, means that much tends to occur outside the law. Aboriginal people prefer to be discreet about their activities to avoid non-Aboriginal interference.³⁴ For this reason, Aboriginal people in the Lower Murray often appear to outsiders to be unnecessarily secretive about their hunting, fishing and gathering expeditions.

A number of studies have urged Australian governments to give more formal recognition to indigenous hunting, fishing and gathering rights over both marine and inland resources (Altman et al 1995; Peterson & Rigsby 1998; Resource Assessment Commission 1993: 166–189; Smyth 1993: 211–225). Other reports have considered the role of Aboriginal people in managing wild animal resources (Altman et al 1997; Bomford & Caughley 1996; Parliament of the Commonwealth of Australia 1998; Wilson et al 1992), and the

³² For a description of the pre-European role of *ngatji*, see Berndt & Berndt (1993: 249–251, 470–473, 417–419).

³³ See Clarke (2002ms) for an explanation of '*gupa*' and '*kuratji* yarns'. Such pre-European style spirits, as distinct from the ghosts of known people, are often associated with areas of old vegetation, such as Block K (Clarke 1999a: 153–155, 160).

³⁴ Brody (1983) gives a detailed description of the plight of Indian hunters in Northwest Canada, which has some similarities to that of modern Aboriginal hunters and gatherers.

complexity of hybrid economies operating in many Aboriginal communities (Altman 2001). To many Aboriginal people in the Lower Murray, access to the environment and its resources was considered important in spite of landscape changes. From the 1980s this has drawn them into greater involvement in environmental issues.³⁵ The use of the landscape by non-Aboriginal people is usually not complementary to indigenous harvesting practices.

In the Lower Murray during the 1980s many older Aboriginal people recognised that, in spite of poor social conditions, a few aspects of their own earlier restricted lifestyle were, in hindsight, desirable. The eating of wild foods, in particular, was considered by them to have made their people 'feel stronger' than they do now. Many elderly Aboriginal people expressed great sorrow that the land they knew in their youth no longer exists.

These people spoke of the contemporary landscape as being 'sick'. Many of the Aboriginal medicine and food plants and animals were no longer to be found and the waters were now turbid and prone to algal blooms. The reserves where hunting, fishing and gathering could take place were few and small, and generally restricted to the Point McLeay–Coorong area. Nevertheless, some Lower Murray people were able to maintain links with their hunter–gatherer past. Such people, from various backgrounds, stressed the importance of their knowledge and use of local foods for the maintenance of their regional Aboriginal identity. Artefact making, in the style of the 'old people', was important in a similar way. A distinct Aboriginal perception of the physical landscape in the Lower Murray persists, though it is radically different from that which prevailed before Europeans arrived.

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³⁵ Hemming (1993), Kean *et al* (1991), Mulvaney (1991) and Young *et al* (1991). In the mid to late 1990s the Aboriginal community of the Lower Murray became embroiled in the environmental and cultural debate over the development of Hindmarsh Island. Consideration of this is outside the scope of the present paper.

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A NEW GENUS OF WATER BEETLE GENTILINA GEN. NOV. FROM AUSTRALIA (COLEOPTERA : HYDROPHILIDAE)

FRANZ HEBAUER

Summary

Gentilina gen. nov. is described and illustrated from Queensland. It comprises one species previously described by Gentili (1993) as *Paranacaena nitens* after a female. The new genus belongs to the subfamily Hydrophilinae, tribe Laccobiini, and comes close to *Hydrophilomima* Hansen & Schödl, 1997 in its external appearance. The aedagophore of a recent specimen is figured and a revised key to the genera of Laccobiini is given.

**A NEW GENUS OF WATER BEETLE *GENTILINA* GEN. NOV.
FROM AUSTRALIA (COLEOPTERA: HYDROPHILIDAE)**

FRANZ HEBAUER

HEBAUER, F. 2003. A new genus of water beetle *Gentilina* gen. nov. from Australia (Coleoptera: Hydrophilidae). *Records of the South Australian Museum* 36(2): 109–114.

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F. Hebauer, Ulrichsberg 7, D-94539 Grafing, Germany. Revised manuscript received 30 November 2001.

It is not at all surprising to continue to discover new genera of insects from Australia. Many areas of this continent are still undercollected for water beetles. In particular, the Northern Territory was found to support new species of Hydrophiloidea such as *Spercheus watti* (Hebauer 1999), *Helochares* spp. (Hebauer & Hendrich 1999), some *Berosus* spp. (Watts 1987) and *Hydrochus* spp. (Watts 1999), as well as Anacaenini and Laccobiini (Gentili 1980, 2000) and a large number of new genera and species of Sphaeridiinae (Hansen 1990). At present there are 45 genera and over 200 species of Hydrophiloidea described from Australia (or 55 genera and over 250 species from the Australian region).

The Hydrophilidae tribe Laccobiini is poorly represented in Australia, until now with the sole genus *Laccobius*. A second genus of this tribe is described in this paper represented by a single species, found at two localities (North Queensland near the Cape Tribulation National Park; and Buderim Mountain). New material is deposited with the following institutions and individuals: Australian National Insect Collection, CSIRO, Canberra (ANIC); Collection of Elio Gentili, Rasa-Varese, Coll. Lars Hendrich, Berlin (CHB); Collection of Franz Hebauer, Grafing, Germany (CHG); Museo di Storia Naturale, Verona (MSNV); Naturhistorisches Museum Wien, (NMW); and the South Australian Museum, Adelaide (SAMA).

***Gentilina* gen. nov.**
(Figs 1–4)

Type species

Paranacaena nitens Gentili, 1993, fixed by designation here. The gender is female.

Diagnosis

Body elongate, widest behind pronotal-elytral junction, contour not interrupted between pronotum and elytra, evenly attenuated posteriorly, weakly convex (Fig. 1). Dorsal face

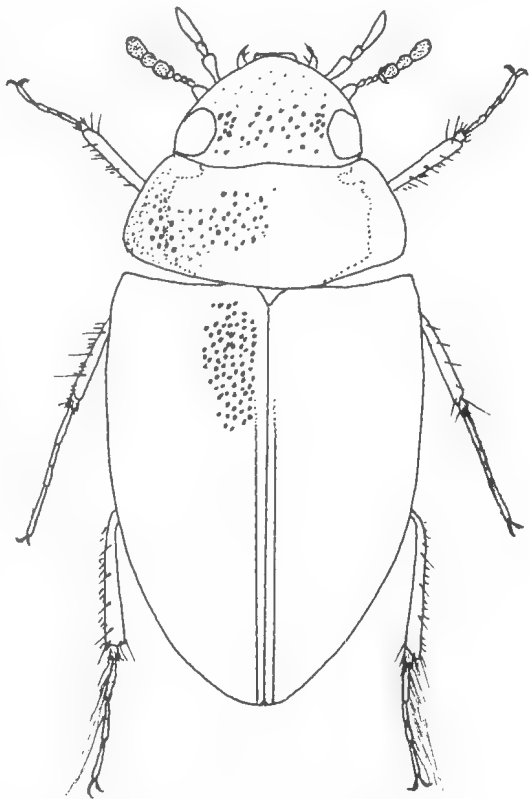


FIGURE 1. *Gentilina nitens* (Gentili), (ANIC), body shape.

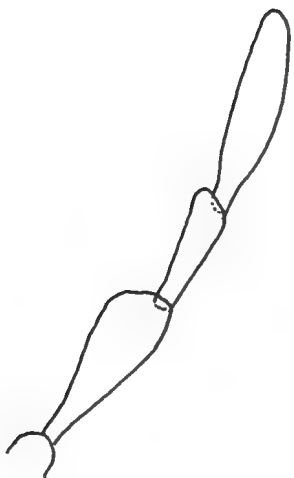


FIGURE 2. *Gentilina nitens* (Gentili), (ANIC), maxillary palp.

glabrous. Clypeus not demarcated from frons by a suture, forming a shelf above antennal base, reaching almost to outer edge of eyes; anterior margin convex, anterior corners rounded. Eyes rather large, separated by about 3x the width of one eye, very slightly protruding from outline of head; anterior margin hardly emarginate. Head slightly narrowed behind eyes. Maxillary palpi half as long as width of head; second segment swollen, apical portion thicker than basal portion; third segment much shorter than second; fourth segment almost twice as long as third, asymmetrical with inner face straightened (Fig. 2). Mentum rectangular, about 1.5x as wide as long, slightly concave, anterior margin almost straight. Labial palpi about as long as width of mentum, slender, cylindrical; second segment without subapical wreath of setae; third segment about as long as second, almost symmetrical. Gula well developed, almost parallel-sided. Antennae 9-segmented, half as long as width of head; first segment of moderate length; second about half as long as first; third to fifth segments very small, subequal; cupule rather small, well differentiated; segments 7 to 9 forming a somewhat compact, pubescent club, which is 3.5x as long as wide (Fig. 3). Pronotum widest at base, sides weakly rounded and strongly narrowed anteriorly; surface evenly convex, without transverse series of punctures at hind margin, but with distinct coarser setiferous punctures forming a short oblique transverse group on each side. Prosternum short, without antennal grooves, not conspicuously elevated medially and without a longitudinal

carina; middle portion defined from lateral portions by a pair of very fine oblique ridges; without spines. Mesosternum not fused to metepisterna, only reaching anterior mesothoracic margin at a single point; middle portion rather flat, without a lamina or projection. Metasternum with weakly raised middle portion, not projecting anteriorly between mesocoxae; with hydrofuge pubescence except for a narrow glabrous area on raised drop-shaped middle portion; without femoral lines. Metepisterna parallel-sided, about 6x as long as wide. Abdomen with 5 visible sternites; first and second of about same length, not longitudinally carinate; posterior margin of fifth ventrite subtruncate as in *Laccobius*, not emarginate medially; all ventrites covered with fine pubescence. Epipleura and pseudopipleura well defined from each other, oblique. Elytra slightly convex, evenly attenuated from shoulder to rounded apex, without punctural series, but with sharply impressed sutural stria in posterior two-thirds; rows of coarser systematic punctures hardly traceable. Scutellum of moderate size, triangular, about as long as wide. Coxae with sparse pubescence; anterior and posterior coxae almost contiguous; middle coxae narrowly separated; all trochanters with dense pubescence. Femora slightly flattened, with sharply defined tibial grooves on inner face. Anterior and middle femora covered with dense pubescence except apical portion; hind femora pubescent on basal half and along anterior margin. Middle and hind

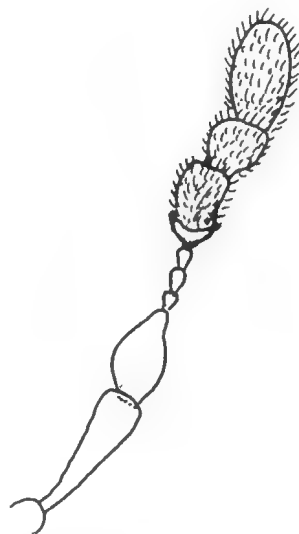


FIGURE 3. *Gentilina nitens* (Gentili), (ANIC), antenna.

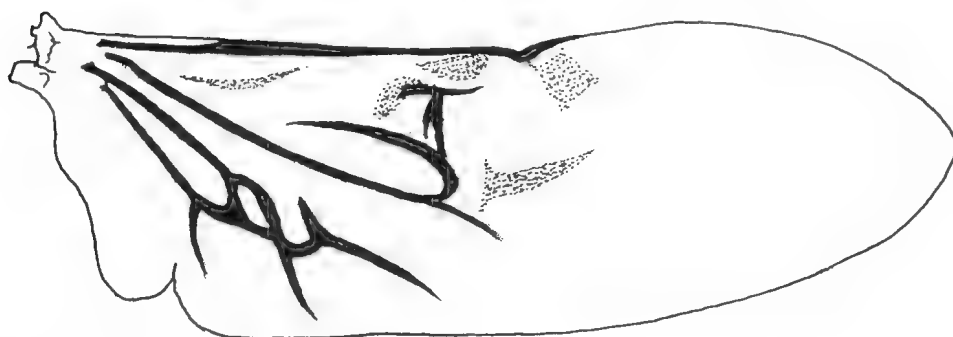


FIGURE 4. *Gentilina nitens* (Gentili), (ANIC), hind wing.

femora completely contacting the trochanter basally. Tibiae slender, cylindrical and straight, with moderately long and moderately strong spines on inner face. Tarsi 5-segmented, long and slender, together surpassing length of tibiae; posterior tibiae with a fringe of long and fine swimming-hairs on outer face. The first segment of middle and hind tarsi short; second segment very long; claws rather small, slightly and evenly curved; without sexual dimorphism. Hind wing almost twice as long as elytra; radial cross vein r4 rising from about middle of radial cell (pigmented area at anterior wing margin); medial (cubital) spur rising from apex of medial loop, reaching a little less than halfway towards posterior wing margin; media distinct and united with cubitus to form a M-Cu loop; wedge cell much smaller than basal cell; anal lobe well developed, demarcated from remainder wing by a sharp excision at posterior wing margin (Fig. 4).

Etymology

The generic name refers to my dear friend Dr. Elio Gentili, specialist in the genus *Laccobius* and discoverer of the type species.

Discussion

This new genus has the following diagnostic features of Laccobiini (Oocyclini), as given by Hansen (1991):

- the presence of systematic punctures on head, pronotum and elytra (sometimes not detectable on all three parts; if completely absent then the pseudopipleuron is at least as wide as the true epipleuron anteriorly or is sharply defined from it by a fine ridge
- the apical segment of maxillary palpi longer than the penultimate.

Anacaenini genera of similar size and colour differ from *Gentilina* in the following characters:

- *Paracymus* has the midprosternum sharply carinate and the maxillary palpi shorter than half as long as the width of the head.
- *Anacaena* has no traces of systematic punctures on head, pronotum or elytra; the pseudopipleuron is narrow throughout, much narrower than the true epipleuron anteriorly.
- *Paranacaena* has, in addition, detectable rows of serial punctures on the elytra.

Gentilina comes close to *Hydrophilomima* Hansen & Schödl and, apart from *Scoliopsis* Orchymont and *Tritonus* Mulsant, it is the only genus of Laccobiini with 9-segmented antennae. Besides *Pseudopelthydrus* Jia, it is the only genus of the tribe with the middle and hind femora extensively pubescent. The present known species ranks with the smallest members of the tribe.

Gentilina differs from the genus *Laccobius* mainly in the 5-segmented abdomen, the 9-segmented antennae and the pubescent femora. From *Pelthydrus* it is distinguished by the 9-segmented antennae, the presence of a sutural stria, and the pubescent femora. From *Pseudopelthydrus*, which also has pubescent femora, *Gentilina* is separated by the 9-segmented antennae and the non-keeled first ventrite. In contrast to *Gentilina*, *Arabhydrus* Hebauer has 8-segmented antennae, its maxillary palpi are distinctly longer (two-thirds as long as width of head) and the second segment is not thickened apically. From the similarly shaped *Hydrophilomima*, the new genus can be distinguished by the middle portion of the mesosternum lacking an elevated portion, the 9-segmented antennae, the swollen second segment of the maxillary palpi being not more than half as

long as the width of the head (about two-thirds in *Hydrophilomima*), the first ventrite being unkeeled, and the extensively pubescent femora (entirely glabrous in *Hydrophilomima*). The genera *Tritonus* Mulsant, *Scoliopsis* Orchymont, *Oocyclus* Sharp and *Beralitra* Orchymont are much larger in size and less easily confused with the above genera because of their striking characters, for example spines, explanate elytra, reniform eyes, acutely pointed hind angles of pronotum.

Gentilina nitens (GENTILI, 1993)
(Fig. 5)

Type material

Holotype (female): Australia: Queensland, Buderim Mtn., Mooloolah, C. J. W. Dec-89 [=1889! C. J. W. = not Watts! The locality is just north of Brisbane] (SAMA).

Paratypes: 4 females as for holotype (SAMA, MSNV).

Additional material: 97 examples: Australia. North-Queensland/Cape Tribulation, Daintree National Park, Turpentine Road, 120 m, 8.xii.1996, Hendrich leg./Loc. 18. (ANIC, CHB, CHG, NMW, SAMA).

Because there is now available a large number of new specimens, including males, a redescription of the species is given here.

Redescription

Length: 1.8–2.0 mm; width: 0.9–1.0 mm. Elongate oval, widest behind shoulders, attenuated behind, moderately convex, black with sides and angles of pronotum widely pale. Head entirely black; clypeus weakly punctate and shagreened, frons rather coarsely and densely irregularly punctate. Maxillary palpi rather long, reaching back to posterior margin of eyes; second segment distinctly dilated on anterior portion, ultimate segment much longer than third, asymmetrical, darkened apically. Antennae 9-segmented. Pronotum widest at base, narrowed anteriorly, shining black with sides and angles broadly yellow; rather coarsely and irregularly punctate; punctured interstices shining. Elytra entirely black, shining, about 1.2x as long as their combined width; coarsely and densely punctate, subseriate; sutural stria sharply impressed in more than posterior half. Irregular rows of coarser punctures hardly traceable. Epipleura oblique. Legs testaceo-brunneous; femora basally darkened; tarsi long and slender, middle and hind tarsi longer than tibiae; with long and fine

swimming-hairs. Underside piceous; abdomen 5-segmented, entirely pubescent, first ventrite not carinate medially, fifth segment subtruncate, without apical excision. Mentum rectangular, slightly concave, rugosely reticulated. Prosternum without median carina and without apical notch. Mesosternum only bluntly bulging medially, without a distinct elevation or projection. Anterior and middle femora pubescent except apical portion; posterior femora pubescent in basal half and anterior margin. Aedeagophore with basal piece rather narrow and slender; median lobe filiform, a little shorter than parameres, bifurcate basally. Parameres broad, strongly convex on outer face and straight on inner face, apices pointed (Fig. 5).

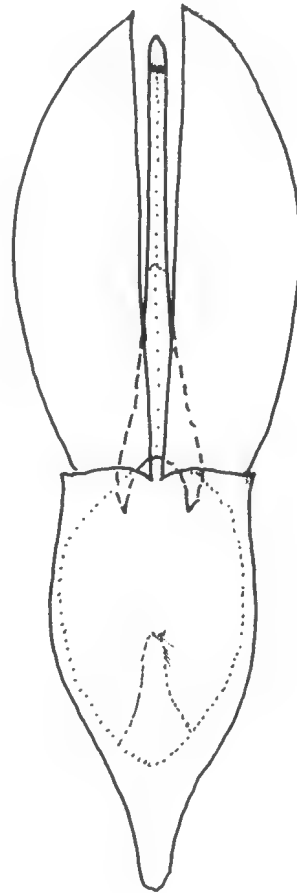


FIGURE 5. *Gentilina nitens* (Gentili), (CHG), aedeagophore.

Distribution

Known only from Queensland. Lars Hendrich (pers. comm.) collected numerous specimens in a small waterfilled rockhole (20 sq cm) in front of a waterfall. The puddle was enriched with some plant debris. The beetles have the habit of flying away immediately when taken out of the water (as in *Agraphydrus* and many *Laccobius*). The small, permanent and almost shaded stream is situated in primary lowland rainforest on private property near the Cape Tribulation National Park.

REVISED KEY TO THE GENERA OF THE TRIBE
LACCOBIINI

- 1 — Maxillary palpi at least two-thirds as long as width of head. Mesosternum broadly reaching anterior mesothoracic margin. First ventrite with median carina, at least basally 2
 - Maxillary palpi less than half as long as width of head. Mesosternum only reaching anterior mesothoracic margin at a single point. First ventrite without a keel 5
- 2 — Anterior and middle femora densely pubescent except at apex, posterior femora pubescent in basal half and/or along anterior and posterior margin. Prosternum almost flat, without median carina—southern China *Pseudopelthydrus* Jia, 1998
 - All femora glabrous or pubescent in less than basal half. Prosternum more or less tectiform, with median carina at least anteriorly 3
- 3 — Abdomen with 6 distinct ventrites. Mesosternum only bluntly bulging posteromedially—Arabian Peninsula (Oman) *Arabhydrus* Hebauer, 1997
 - Abdomen with 5 distinct ventrites. Mesosternum abruptly raised posteromedially, forming a strongly margined, elevated portion 4
- 4 — Metasternum with narrow, somewhat flattened, glabrous median ridge which is connected with median ridge of mesosternal elevation to form a continuous sternal keel. Femora with well-developed tibial grooves on inner face—Oriental region *Hydrophilomima* Hansen & Schödl, 1997
 - Metasternum simply convex, often more shiny in middle portion, but without median ridge, anteriorly well demarcated from mesosternum. Femora without well-defined tibial grooves on inner face—Oriental and eastern Palaearctic regions *Pelthydrus* Orchymont, 1919
- 5 — Abdomen with 6 distinct ventrites. Trochanters of posterior legs very large, not completely abutting femora, but with bluntly projecting apices. Posterior tibiae usually curved—worldwide (except South America) *Laccobius* Erichson, 1837
 - Abdomen with 5 distinct ventrites. Trochanters of posterior legs of moderate size, not freely projecting apically. Posterior tibiae straight 6
- 6 — Elytra with distinct sutural stria in about posterior half. Antennae 9-segmented .. 7
 - Elytra without distinct sutural stria, but sometimes with the sutures a little elevated posteriorly. Ventrites uniformly pubescent and punctate. Antennae 8-segmented ... 9
- 7 — Second to fifth ventrites with large well-defined, glabrous and almost impunctate areas medially 8
 - All ventrites pubescent—Australia *Gentilina* gen. nov.
- 8 — Posterior corners of pronotum angulate, not produced into a long acute spine. Pro- and mesosternum without spines. Eyes hardly oblique in dorsal view—Mauritius *Tritonus* Mulsant, 1844
 - Posterior corners of pronotum produced into a long acute spine. Pro- and mesosternum with some strong spines medially. Eyes obliquely shaped in dorsal view—Sri Lanka *Scoliopsis* Orchymont, 1919
- 9 — Elytra a little explanate towards margin, the suture distinctly raised posteriorly. Body weakly convex—South America *Beralitra* Orchymont, 1919
 - Elytra not explanate towards margin, the suture not raised. Body often more convex—Oriental and Neotropical regions *Oocyclus* Sharp, 1882

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REPAINT THE DRUM

B. CRAIG

Summary

A large slit-drum from Ambrym in Vanuatu was presented to the South Australian Museum in June 1996. This drum became the catalyst for a review of the museum's collections originating in New Hebrides (Vanuatu) and for an Adelaide Arts Festival event in March 1998. In order to organise the Festival event, the author went to Vanuatu for three weeks, also visiting several locations in central Vanuatu to document items in the museum's collections and to purchase contemporary objects for an exhibition, *Spirits of Vanuatu*.

REPAINT THE DRUM

B CRAIG

CRAIG, B. 2003. Repaint the drum. *Records of the South Australian Museum* 36(2): 115–133.

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THE PROJECT

In June 1996 Mrs Claire Murray of Adelaide donated to the South Australian Museum a 2.8 metre high slit-drum (A.74765, Fig. 1) from Vanuatu in memory of her late husband and his deep interest in the music of the Pacific Islands. Claire and Bryan Murray had bought the drum from a shop in Port Vila in 1974. The drum had lost its colours and the Murrays were unable to determine its exact origin and who had carved it.

The receipt of this drum became a catalyst for research on the extensive collections from Vanuatu¹ held by the South Australian Museum. By comparing the style of the carving on the drum with published information (Bonnemaison et al 1996, Fig. 333, second from left; Clausen 1960, Figs 18–21; Speiser 1990, Plate 105, Nr 6), it became clear that the drum was from the island of Ambrym in central Vanuatu.

I read that the slit-drum is likened to the voyaging canoe. The people of Vanuatu are believed to have arrived in their present lands by way of the outrigger canoe some 3200 years ago (Spriggs 1997: 40). They have maintained contact among their many islands since then using large trading vessels.²

Clausen believes it was the dugout that provided the model for the slit-drum. The same kind of tree, and the same carving and hollowing techniques, are used, and the forms are similar. He wrote (1960: 19):

... just as the canoes transport man over the ocean and are thus the means by which the ocean can be used, to the benefit of man, for purposes of trade (mainly in boars, sows and small piglets); so also, the slit-drums are like canoes on the ocean of the spirit world, connecting mankind with the otherwise unknown world of the ancestral ghosts whose voices they represent and who live on – literally feed on – the psychic essence of the boars that are sacrificed to them. Slit-drums thus constitute a psychic medium of communication with the spirit world corresponding to the trading voyages of the canoes in external life.

The French ethnographer Joël Bonnemaison (1994) suggests that the voyaging canoe and the networks it creates are metaphorically central to Melanesian concepts of space and time.

Among the northern and central islands of Vanuatu a wide range of goods were traded (Huffman in Bonnemaison et al. 1996: 182–185). These included shell ornaments from the Banks Islands; pottery from the west coast of Santo; red dye from south Santo; green paint from Malekula; woven mats, aprons, belts and baskets from Malekula, Ambae, Maewo and Pentecost; and everywhere pigs were an enthusiastically accepted trade item. Canoes were obtained from northeast Malekula, Lamen, north Ambrym and south Pentecost, because not all the islands had trees large enough to provide suitable hulls. Trade in pigs, foodstuffs, bows and arrows, and shells also took place between inland tribes and coastal

¹ Called New Hebrides until, in 1980, independence was gained from the British–French Condominium, sardonically termed the 'Pandemonium' by some residents.

² For an illustration of one of these vessels, see Bonnemaison et al 1996, Fig. 214.



FIGURE 1. Slit-drum (*a-tin-tin*) (A.74765); commissioned by Taimal and carved from breadfruit tree (*pita*) by Tin Mweleun (Golele), of Fanla village, north Ambrym in 1968. Purchased at Port Vila in 1974 by Bryan and Claire Murray, Adelaide. Donated to the South Australian Museum 8 June 1996 by Claire Murray in memory of her late husband, Bryan. Repainted and ritually named 'Fanla' by James Taimal of Fanla and Billy Bong of Ranon, north Ambrym, 12 March 1998. Photo: Trevor Peters, SA Museum.

peoples on the larger islands, facilitated by strategic intermarriage.

Not only objects and materials, but rituals, ritual objects, masks, myths, songs and dances, were traded through a system which respected copyright and required appropriate payments to be made. The more complicated economic transactions involved notions of credit and loans and compound interest. The basic item of value was the pig, the most valuable being those bred with curving tusks, particularly tusks in the form of a double circle. The Swiss ethnographer Speiser said (1990: 246), 'the pig is the standard of value and all other values are related to the pig'.

Thus, in Vanuatu the slit-drum links ritual with canoes and trading voyages; and also masked ceremonies and grade figures with the production and exchange of trade goods (eg pigs and their spiral tusks, shell valuables, and woven mats, pots and pigments).

It occurred to me that the slit-drum donated by Claire Murray could act as a catalyst for the revival of the relationship between South Australia and Vanuatu implicit in the collections held by the Museum. Up until now, South Australians (eg Reverend William Gray, a Presbyterian missionary who served on Tanna, 1882–1895) had gone to Vanuatu and brought back material embodiments of their encounters with the people and cultures of that tropical archipelago. Perhaps now we could invite a ni-Vanuatu man to come to Adelaide to restore the pigments on the drum and ritually install it in the foyer of the Museum.

This would be in accordance with the Museum's current practice of having people from cultures represented by its collections come to the Museum and present aspects of their culture directly to the public. It has happened many times in relation to Aboriginal Australian cultures but only once before in relation to Melanesian cultures – when masked dancers came from New Ireland and East New Britain for the 5th International Pacific Arts Symposium hosted by the South Australian Museum in April 1993 (Chance & Zeppelin 1993; Craig 1993, 1994, 1995; Zeppelin 1993).

I approached the Friends of the South Australian Museum for a grant to fund the project and this was successful. Enquiries through Dr Darrell Tryon, a linguist at the Research School of Pacific and Asian Studies at the Australian National University in Canberra, provided me with the understanding that the drum could be refurbished and beaten only by a man of

the correct chiefly lineage. In due course I was provided with the name of an Ambrym man working for AustAid at Port Vila who was of the correct lineage. Over the next few months I attempted to arrange for him to come to Adelaide to repaint the drum, but his work commitments led to deferral of the project.

In the meantime, I had urged the Museum to consider supporting exhibition projects consistent with the theme of the 1998 Adelaide Festival of Arts, which was 'Sacred and Profane'. Around the middle of 1997 I was asked if I could organise the repainting of the Ambrym slit-drum as an official Museum event for the Festival. I had realised by then that the only way that such a project could become a scheduled event would be by going to Vanuatu to identify who could come for that particular date, make all the accommodation and travel arrangements, and find out what needed to be provided to make it a successful presentation of Vanuatu culture. I proposed a modest budget to supplement the funds committed by the Friends and this was accepted.

THE OBJECTIVES

The opportunity to seek out the correct man or men³ for this work would enable me to do other things as well. My fieldtrip proposal therefore had four objectives:

- To establish a working relationship with the Vanuatu Cultural Centre at Vila by providing for its archives a set of photographs and a computer print-out of around 580 of the South Australian Museum's Vanuatuan objects.⁴
- To add to the documentation of the South Australian Museum's Vanuatuan collections by using these photographs to obtain further cultural information.
- To purchase, and document with notes, photographs and audio tape recordings, and contemporary ethnographic material in Vanuatu to supplement the present collections in the South Australian Museum, and to use these objects in the redevelopment of the Vanuatu exhibits in the Museum's Pacific Gallery.

- To identify, and arrange for, one or two ni-Vanuatu men to travel to Adelaide for the Adelaide Festival of Arts in March 1998 to repaint the Vanuatu slit-drum and perform the relevant rituals prior to its installation in the main foyer of the South Australian Museum.

I also thought it might be possible to find out more about this particular drum by showing a photograph of it to Ambrym men. It happened that in late October 1997 the volunteer fieldworkers of the Vanuatu Cultural Centre would be attending a workshop run by Darrell Tryon and Ralph Regenvanu, the Director of the Cultural Centre. For many years these workshops have been held annually, each year having a different theme.⁵ The volunteer fieldworkers meet for two weeks in Vila, bringing videotapes, audio tapes, photographs and information on each year's particular theme gathered from the knowledgeable people in their areas. This information and supporting materials are then archived for future reference and research.

There would be men from Ambrym at the workshop; I would be able to show them the photograph of the drum for identification and they would be able to suggest the appropriate persons to come to Adelaide. The fieldworkers also would be able to suggest an itinerary for two weeks of travel through the islands of central Vanuatu for the purpose of gathering information and purchasing contemporary objects for the Museum's collection. Darrell Tryon assured me that my facility in New Guinea Pidgin English would enable me to be understood quite well; Bislama, the Vanuatuan creole, is quite similar to PNG Pidgin. As well, in many of the islands, Vanuatians have a serviceable ability in English.

In preparation for the trip, Scott Bradley was contracted to photograph the entire collection from Vanuatu. Maria Troiano was engaged as a research assistant for a short time to bring together all the documentation relating to the collections, develop a working bibliography of the history and ethnography of Vanuatu, and identify the main collectors (Table 1). It was clear that a three-week fieldtrip and a modest budget would not be sufficient to visit all the places from which the collections had come (see map, Fig. 2). I decided, therefore, that I should visit:

³ Although the repainting could probably be done by one man, it is my experience that village-based Melanesians generally feel uncomfortable travelling in foreign countries, or anywhere outside their own daily sphere of interaction, by themselves.

⁴ The actual total appears to be around 670 items.

⁵ See Sam, and Huffman, in Bonnemaison et al 1996: 288–293; Fig. 366 shows fieldworkers gathered for such a workshop in 1994.

TABLE 1. Main South Australian Museum collections from Vanuatu.

Collector	Year(s)	Number of items
'Old Collection'	Mostly late 19th century	159
Rev. W. Gray	Collected 1882–1895	about 90
Bishop Cecil Wilson	Early 20th century	66
J.H. Johnson (ex-Young Collection)	Probably late 19th century	49
R.J. Etheridge	Early 20th century	46
Rev. J. Palmer	Late 19th century	35
G.L. Pretty	1971	25
Douglas Mawson	1903	at least 23
Stacey Collection	Late 19th century	22
Dr R.J. Roach (ex-Theodore Thomas, an 'early planter')	Probably late 19th century	18
A. Adamson	Early 20th century	15
M.I. Savage	Early 20th century	14
Australian Board of Missions (Rev. A.S. Webb collection)	Probably early 20th century	11
Other sources	Late 19th–20th centuries	about 100
TOTAL		at least 670

- the tiny islands of Wala and Vao (Layard 1942) off the northeast coast of Malekula, which were once thriving bases for canoe trading voyages throughout central Vanuatu;
- Wuss (nowadays called Wusi), a village on the west coast of Santo from where Douglas Mawson purchased three clay pots and other objects in 1903 (Mawson 1957) and where the skills persist to this day (Galipauid in Bonnemaïson et al 1996: 97–99);
- Lolowai on east Ambae, where there was an industrious community of women mat-weavers and basket makers (Bolton in Bonnemaïson et al 1996: 112–119);
- Ambrym, to see the village from which the Museum's slit-drum came and make arrangements for the repainting event in Adelaide.

THE JOURNEY

We⁶ spent four days in Vila. I attended the fieldworkers' workshop and recorded information about objects in the South Australian Museum's collections on the basis of the photographs I had brought with me. I was informed that the slit-drum had come from Fanla, a village on the north coast of Ambrym, not far from Ranon. James Taimal told me that his father, Chief Taimal, had

commissioned the carving of the drum by Golele in 1968. James and Billy Bong volunteered to come to Adelaide to do the repainting of the drum. This was agreed to by all concerned. So that I could visit the place where the drum was carved, I made arrangements for a launch to pick me up at Craig Cove to take me to Ranon. Billy and James would have returned to Ambrym by that time. Arrangements also were concluded for the visits to the other places on the itinerary.

Malekula

The first stop was northeast Malekula (Norsup) then by road and launch to Wala Island. There I saw a canoe with a carved prow attached, featuring a bird (*soliip*) and flying-fish (*nuwawalades*) motif (cf. Bonnemaïson et al 1996, Fig. 51). Although I sought to purchase this, the owner did not want to sell and I later bought a newly-carved one (A.74721) from Malili Kami, a Wala Island Guest House guide (Fig. 3). There were no canoe prows in the collections of the South Australian Museum so this was a significant acquisition, particularly as Malili told me that the *soliip* bird is featured on the prow because it is this bird which navigators use as a guide to land if they get lost out at sea.

The Museum also has two identical masks (A.7430, A.7431, obtained from Reverend Gray, 1895) each topped with a model of a white bird with long narrow wings, a long forked tail and a

⁶ I was accompanied by my eight-year-old son, Sai, at my own expense.



FIGURE 2. Map of Vanuatu.

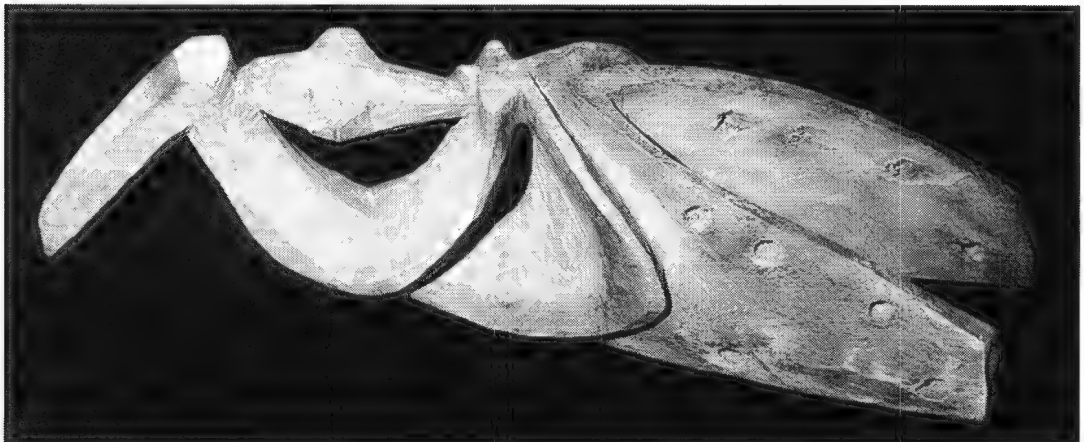


FIGURE 3. Canoe prow (A.74721) featuring bird (*soliip*) and flying fish (*nuwawalades*). Purchased by B. Craig from Malili Kami of Wala Island, northeast Malekula, 1997. Photo: B. Craig.



FIGURE 4. Mask (A.7430) with tern (*soliip*) on top; obtained from Rev. W. Gray 1895. Northeast Malekula. Photo: B. Craig.

black mark on its head (Fig. 4). I asked about this type of mask and was told it was from northeast Malekula, it is called *bang-lulu* and the bird is *soliip*, the same species as on the canoe prow. On return to Adelaide, on the basis of the colour, markings and other characteristics of the bird on the masks, I identified it as most likely the Roseate Tern (*Sterna dougalli*) (Bregulla 1992: 162–163; duPont 1976: 60, Plate 12, E). This

information is contrary to Kaufmann's hypothesis (in Bonnemaïson et al 1996: 33) and Tilley's conviction (1999: 109–111) that the carved bird on the canoe prow represents the frigate bird. I, too, had suggested this to my informants but they assured me that this was not so.

At the 'Small Nambas kastom village' on Malekula just opposite Wala Island, the people put on a two-hour spectacle of dances, explaining the arrangement of the dance ground (*namel*). There was a spirit guardian figure at the west end (Fig. 5) and a row of ten family shrines (Fig. 6), each featuring a carved post and a carved bird (*nmbel*)⁷ with outstretched wings at the peak of



FIGURE 5. Spirit guardian figure at dance ground (*namel*) of Small Nambas Kastom Village, northeast Malekula. Photo: B. Craig.

⁷ Coiffier in Bonnemaïson et al 1996: 222 (see also Fig. 41) identifies this bird as the sparrow-hawk.



FIGURE 6. Part of a row of family shrines at dance ground of Small Nambas Kastom Village, northeast Malekula. Photo: B. Craig.

the gable (also a feature of men's cult houses on the middle Sepik River in Papua New Guinea – see Craig 1987: Plate 30).

There were several large standing slit-drums, which are beaten with coconuts, and small horizontal slit-drums, which are beaten with short, thick wooden sticks. Several drums were played as an ensemble and the rhythms were quite complex, which surprised me as I am accustomed to the relatively monotonous rhythms of the New Guinea hand-drum.

Some of the dances referred to the planting of yams and of other protective plants around the yam mound. One dance featured the men holding carved and painted paddles, commemorating the first crossing of the people from the Malekula mainland to the offshore islands of Wala, Atchin and Vao. Another dance reminded me of Australian Aboriginal dances as it entailed bird-like movements and gestures, and the kicking-back steps, which raised a lot of dust. The dancers emphasised the rhythm by stomping short bamboo tubes vertically on the ground. Yet another performance featured a pantomime, with one man

chasing and beating another who was covered with black ash and hobbling 'painfully' with the aid of a stick, causing men, women and children to shriek with laughter. The women and girls danced in a group separate from the men and boys but it was noticeable that children, even toddlers, were encouraged to join in with the adults.

Although the dances were put on for us as tourists, everyone had a good time and of course they were paid, via a charge levied through the Wala Guest House. A few artefacts were offered for sale, which also provided a source of income. I was assured that the dance ground was used also for traditional grade-taking ceremonies and was therefore not just a tourist attraction.⁸

The next day, on Vao Island I saw partly overgrown *nasara*, ancient ceremonial dance grounds with huge stones set up. Some were still being used for ceremonies, with several large slit-drums in place (Fig. 7).

An interesting cultural feature I noted was the presentation of yams tied to a row of leaning poles, set up for a circumcision ceremony. The likeness to yam presentations among the Abelan

⁸ Christopher Tilley (1990: 239–259) provides an extended description and analysis of the 'Small Nambas' dance ground and performances, based on his visit a few years before mine.



FIGURE 7. Slit-drums at dance ground of Vao Island, northeast Malekula. Photo: B. Craig.

of the East Sepik Province of Papua New Guinea immediately sprang to mind (cf. Hauser-Schaublin 1989, Abb. 141).

After photographing the yam displays I was taken to a nearby village house, and Paul Malep showed me a range of carved wooden hand-held masks for sale. These were reminiscent of a mask in the South Australian Museum (A.7760, Fig. 8) mistakenly attributed to Santa Cruz.⁹ According to Huffman (in Bonnemaison et al 1996: 23–24), this type of mask from Vao is called *narut* (generic term) and is ‘used in tragicomedy mime sketches interspersing stages in the extensive grade rituals’. I was told that some of these masks are named *melo’ombuli* and were used by men to enforce presentation of food by the women during ceremonies. This reminded me of the function of certain *vanis* masks on the Tabar Islands of New

Ireland Province, and of the Sulka *keipa* masks of East New Britain Province, Papua New Guinea.

Back on Wala I purchased a stone janus head (A.74723), recently carved by Franco Siptiley, complementing a similar object (A.74720) I had bought at the ‘Small Nambas kastom village’. Both are called *dimetsmiel* and represent a spirit that can be induced to make rain, or other desired outcomes, depending on the owner’s rights to, and knowledge of, particular spells. Some stone heads are used for pig magic, according to Rodman (in Bonnemaison et al 1996, Figs 195–199).

In the late afternoon I joined a group for a tour of ancient dance grounds on Wala. They have not been used for many years and are overgrown but our guide informed us that there are plans to clear the saplings and bushes that have sprung up, restore the sites and use them for ceremonial

⁹ It is almost identical to the one illustrated in Meyer 1995, Plate 18 (L.4103, Linden-Museum, Stuttgart), and similar to the masks in Speiser 1990, colour plate xlviii (Vb 4757, Museum für Völkerkunde, Basel), and in Bonnemaison et al 1996, Fig. 32 (20933, Musée d’Ethnographie, Genève).



FIGURE 8. Hand-held mask (A.7760), 'Old Collection'; probably Vao Island, northeast Malekula. Photo: B. Craig.

occasions. The old trees and stones lining one side of each dance ground were impressively large, creating an atmosphere of ancient ancestral power. If they revive ritual activities in such places, not only would visitors be impressed, but also the initiates themselves.

Espiritu Santo

The next flight was from Norsup to Luganville on the island of Espiritu Santo. Luganville is the only town in Vanuatu other than the capital, Port Vila. From there we travelled west by road to Tasiriki and by launch up the west coast to Wusi. The west coast of Santo is steep and rocky, with few places to go ashore. Wusi is located on a broad flat area formed by alluvium from a large stream that has cut a valley deep into the mountains. This is one of the few places in the volcanic islands of Vanuatu where clay suitable for making pots could be found. Pots made here therefore were traded widely throughout central Vanuatu.

In 1903 Douglas Mawson spent six months on a geological field trip in Vanuatu. His original field note books and some photographs he took are part of the Mawson Collection, now located in the South Australian Museum. I found that he recorded information of cultural relevance only when he was on the west coast of the island of Espiritu Santo. These references, under the date 16 July 1903, include detailed notes on pot-making (which he later published, see Mawson 1957), a story about a skull he collected (which I have not yet tracked down), and a brief note recording the purchase of a few ethnographic objects: 'Curios: 2 conches, 1 bow & 10 arrows – bone pointed, 1 mat, 1 piece of turtle shell, 3 pots, 1 plate (broke)'.

In the diary it is implied these items were purchased at Wuss (Wusi) as the pot-making was observed there and the note is followed by the comment, 'Had a bad passage down to Tasiriki, landing at 9.55.' However, the 25 Vanuatu items Mawson gave to the South Australian Museum in 1955 only partly correspond to the note quoted above. His donation consisted of the following items:

One mask (no specific location); one basket (Santo); one apron, 'worn behind to sit upon' (Efate); two spears (no data); one bow (no data); two bows and fourteen arrows (only seven bone-pointed) from Banks Is, obtained from Dr Bowie¹⁰ of the chief mission station on Espiritu Santo who collected them 'long before 1903'; two pots (Wuss village, Santo); one rat trap (Aoba).

A donation of 86 objects by Lady Mawson after Sir Douglas Mawson's death in 1958 included

¹⁰ Reverend F.G. Bowie of the Presbyterian mission, based at Tasiriki.

around 50 pieces from Vanuatu. While many of Mawson's pieces have labels attached, with collection details in his handwriting, others appear to have lost their labels; further research will be necessary to identify all the material from Vanuatu.

Although he does not mention it in his field diaries, the labels confirm that Mawson collected material from locations other than on the west coast of Santo and, to further confuse matters, some pieces may have been lost or given away. For example, there are two Santo pots from Mawson in the Museum (A.48082, -3) and a similar pot (A.29997) from Howchin, a friend and respected senior colleague of Mawson. Perhaps Mawson gave a Wusi pot to Howchin. It is therefore quite possible that these three pots are the three referred to in Mawson's diary.

During the next two days at Wusi, I purchased 21 pots from five women (A.74724–38, 74740–5), nine of which were made by Vera Mei-u (Fig. 9) who is illustrated making pots in Bonnemaïson et al 1996, Figs 106–107. I recorded six pot types. I showed Vera Mei-u photographs of Santo pots in the South Australian Museum (from Mawson, Howchin, Gray and Macmillan) and obtained information on what the pots are called, what the designs are called, and what types of food are cooked in them. Information on contemporary



FIGURE 9. Vera Mei-u, potter of Wusi, Espiritu Santo. Photo: B. Craig.

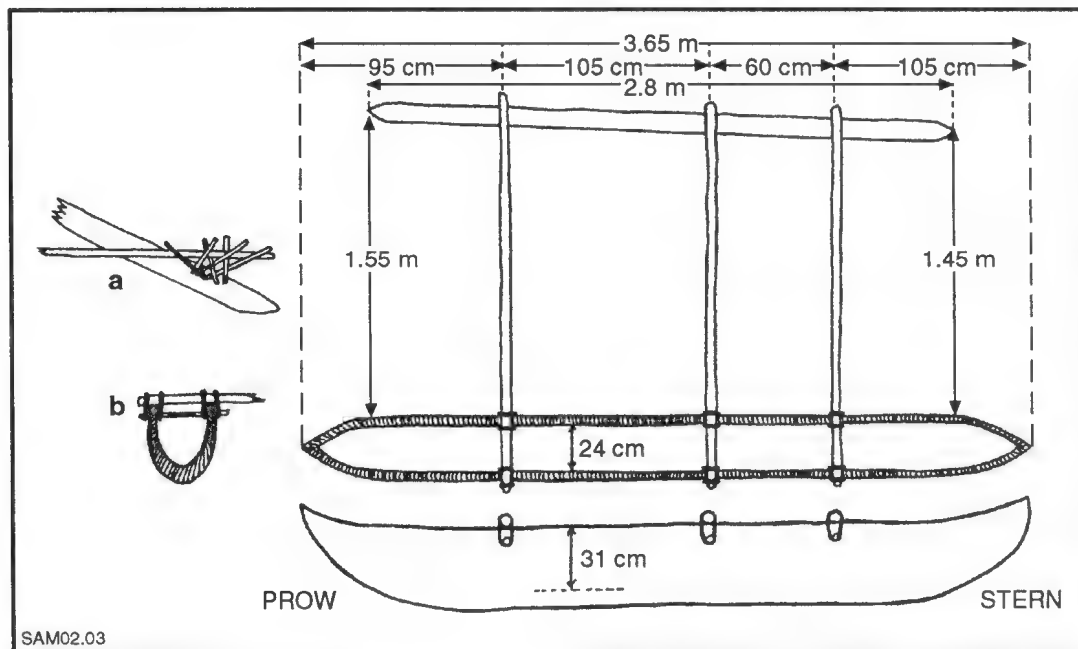


FIGURE 10. Plan of typical outrigger canoe, Wusi, Espiritu Santo. a. outrigger attachment; b. attachment of boom to gunwale.

pottery has been published by Galipaud (in Bonnemaïson et al 1996: 97–99).

There are no longer any of the large trading canoes to be found in Vanuatu but plenty of small outrigger fishing canoes can be seen. Eight were pulled up on the beach at Wusi so I photographed and measured them all. I used the average of these measurements to draw a plan of the 'typical' outrigger canoe of west Santo (Fig. 10). It is interesting that, based on his observations during 1910–12, Speiser wrote (1990: 224), 'In northern Santo...boats are very rare...[and people] on the west and southwest coast of Santo hardly ever venture onto the water'.

Ambae (Aoba)

Returning to Luganville, we flew to Longana on east Ambae and were driven to Lolowai where accommodation had been arranged. Several women gathered to demonstrate their basket-making and mat-weaving skills. We were invited to Lolovoli village to see a drum and dance performance the next day.

This performance perfectly illustrated Crowe's description in Bonnemaïson et al (1996: 157):

In east Ambae slit-gong ensembles, the largest

gong is called *ratahigi*, the middle gong *simbegi* and the small gong *valagi*. The ensemble is likened to a voyaging canoe, where the gongs are 'captain', 'helmsman' and 'crew' respectively – the 'crew' may be several small gongs – and on the dance ground the *ratahigi* controls the ritual sequencing (items, stops and starts), the *simbegi* directs the speed of the items in sync with the dancers and the *valagi* provides rhythmic embellishment.

The dance we witnessed at Lolovoli, called *tikor*, was accompanied by five slit-drums – a large *ratahigi* over 2 metres in length; a *simbegi* just over a metre and a half in length; two *valogi* about a metre in length and a small *valogi* just over half a metre long. They were arranged in a horizontal position in an open-sided hut next to the dance ground and were undecorated (Fig. 11).

The 'captain', Joseph Maori, was an old man, strong and steady, laying down the basic rhythms. The 'helmsman' was Edward Garai, wiry, full of vigour, flashing his teeth, his whole upper body animated with the complex beats by which he directed the tempo of the dozen dancers led by Aaron Ang'ga. The three 'crew' – David Boi, Moses Tafoa and another man – ornamented the progress of the work.



FIGURE 11. Drum ensemble performing at Lolovoli, west Ambae. Photo: B. Craig.



FIGURE 12. Women weaving mats, Lolowai, west Ambae. Photo: B. Craig.

The drummers' and dance leader's names reflect the history of Christian missionary activity in these islands but 'kastom' persists alongside the new ways, and there is no conflict in their minds between the notion of respect for the ancestors and respect for the Christian God.

The next day I was presented with a written program of activities demonstrating the processes of weaving and dyeing mats.¹¹ Apart from pigs and pig tusks, perhaps the most important trade items in central Vanuatu were the mats woven by women (Fig. 12) from strips of pandanus leaf (*Pandanus tectorius*), often with abundant fringes and using designs dyed a brownish-red. This dye used to be obtained from the bark of *Ventilago neocaledonica*, but the women said that this plant

is increasingly difficult to find so nowadays they buy imported red, purple and blue dyes from the trade store. They still use a yellow dye from the grated rhizome of a plant called *ang'or* (turmeric?). In the southern half of Vanuatu it would appear that tapa cloth performed some of the same functions as mats in the northern half, but tapa is rarely made today.

To prepare a mat for dyeing, it is first tied around a log of suitable circumference. Linear geometric designs are produced by binding short strips cut from the stems of *Heliconia indica* over the mat using a rope that is permeable to the dye to produce white motifs on a coloured ground; this type of mat is called *singo* on east Ambae. More complex, curvilinear motifs are achieved by binding on stencils cut from layers of the trunk of a banana plant; this type of design is used on mats called *gwana*. Long mats, either uncoloured or dyed in a single block of colour, are called *maraha*.

When the mat has been prepared it is then laid in a galvanised iron trough of hot dye which simmers over the flames for 15 to 30 minutes. The mat is then taken out of the trough, the stencils are removed and the mat is dried in the sun.

The *gwana* mats may be worn by women as clothing or may function as blankets and floor mats; *maraha* may be used to wrap the dead; *singo* are worn by men and indicate status in the grade system. *Gwana*, and especially *maraha*, are used as items of exchange, functioning as traditional 'money'. They are most important as marriage gifts from bride's family to bridegroom's family (Bonnemaison et al 1996, Figs 122, 123, 129), symbolising the fertility of women in opposition to the curved pigs' teeth which represents men's reproductive substance (Walter in Bonnemaison et al 1996: 108).

Baskets of all shapes and sizes, some with intricate coloured designs – including names – woven into them, are also of great importance as containers and carry-alls, there being no tradition here of looped string net bags as in Papua New Guinea.

Following the demonstration of weaving and dyeing, dozens of mats and baskets were laid out for me, from which I chose seven mats (A.74748, 74750-55) and four baskets (A.74746, -47, -49, -56) of different types for the Museum.

¹¹ For a brief description of the social significance of mats and of mat-making and dyeing on Ambae, see Bolton in Bonnemaison et al 1996: 112–119; and for an extended study, see Bolton 1993. Eleanor Williams (1928) reported mat-making on Pentecost Island.



FIGURE 13. Dance ground at Fanla, north Ambrym, showing slit-drums, grade figures and men's house. Photo: B. Craig.

Ambrym

We flew back to Luganville and caught the plane to Craig Cove, west Ambrym, for the final stage of the fieldtrip. An outboard-powered launch took us to Ranon on the north coast, where we were met by Billy Bong and shown to a little Church-run guest house. I noticed a carvers' workshop on the beach with several unfinished slit-drums and grade figures inside. I arranged with Billy to visit Fanla, a village up on a ridge a few kilometres east of Ranon, the next day. This was where the slit-drum bought by Claire and Bryan Murray had come from. That night we slept with the sulphurous fumes of Mt Benbow drifting through the village.

The next day we walked up to Fanla and found James Taimal, and I obtained further information about the slit-drum (*a-tin-tin*) at the South Australian Museum. It had been carved by Golele (also known as Tin Mweleun) under commission from Chief Taimal (James's father) around 1968 from a breadfruit tree log (*pita*). I photographed the dance ground with its slit-drums, grade figures and men's house (Fig. 13), and purchased for the Museum one of the unpainted grade figures (*mage*) carved from tree-fern (*palang*) by Alili Molkaun about 1990 (A.74757).

The sacrifice of pigs is essential for all ritual occasions, especially when men seek to move upwards in the competitive grading systems. A visible marker of grade-taking is the tree-fern or wood figure carved by the grade-taker and erected on the dance ground. Bonnemaison says of grade-takers in south Malekula (Bonnemaison et al 1996: 209),

As he rises, the man of high grade becomes a

supernatural being, hedged about with numerous tabus and kept carefully apart from the world of the 'living'...the man of high grade here is a man who has joined the community of his ancestors.



FIGURE 14. Chief Pong Randi of Ranon, north Ambrym, playing mouth-bow. Photo: B. Craig.

We returned to Ranon and arrangements were concluded with Billy and James for their travel to Adelaide in March to repaint the slit-drum. They were to bring red, white and black pigments, a mallet and chisel for demonstration carving, and powdered kava for the feast to follow the installation of the drum. I agreed to supply a pig, taro, yam and sweet potato for the feast.

Before returning to Craig Cove the next day, we were invited to hear Chief Pong Randi demonstrate his musical skills using a mouth-bow (*yutoto*) and a long, end-blown bamboo flute (*liblabo*). I photographed the Chief playing a few songs on each instrument (Fig. 14) and was able to purchase them for the Museum (A.74759 and A.74758 respectively). These instruments were virtually identical to those obtained by the Museum from Reverend Gray in 1895 (A.29998 and A.8387 respectively).

At Craig Cove I was handed a letter by Ramel Bong for the Director of the South Australian Museum regarding the concerns of the men of west Ambrym about a *rom* mask in the Museum's collections (cf. Bonnemaïson et al 1996: 327–329, Fig. 18). This mask (A.7433 – see the cover of Ling 1982) was collected by Douglas Mawson in 1903. It is not currently on display although it used to be, at least from 1949 until around 1992. The men of west Ambrym stated categorically it should not be placed on public display and must not be seen by anyone not of the proper grade, although they had no concern about the display of photographs of it. However, the letter proposed that we could pay 50,000 vatu (approx. Aust. \$600) to obtain the right to exhibit the mask.

The *rom* mask's specific name is *bati pasel* and it is normally destroyed after the ceremony in which it is used. I took the opportunity to explain the SA Museum's policy, and facilities, for dealing with Aboriginal secret-sacred material and suggested that we could do the same sort of thing for this *rom* mask if the Director decided not to purchase the right to display it.

In Vila I spent the next two days packing the collection, getting it fumigated by Quarantine and obtaining export permits from the Vanuatu Cultural Centre. Arrangements were made with Ralph Regenvanu, the Director of the Cultural Centre, for ensuring that the trip to Adelaide by Billy Bong and James Taimal would proceed smoothly. I reflected with surprise that the whole trip had gone like clockwork.

THE RESULTS

Establish a Working Relationship between SA Museum and the Vanuatu Cultural Centre

Before departing for Vanuatu, almost the entire collection of around 580 Vanuatuan objects, both on display and in storage, was photographed and the prints placed in two photo albums. Reference numbers and collection registration numbers were written beside each photograph and a computer print-out was included.

The album provides an understanding for the Vanuatu Cultural Centre of what types of objects we have in our collections in Adelaide. This may be of assistance for planning exhibitions in Vanuatu of material not held in the Centre's own collections but which could be sent on loan for that purpose. It may also be useful for identifying material for repatriation should that become an issue. Reference to individual photographs may also be of assistance in gaining further information, by email and correspondence, about the objects depicted in them.

Documentation of SA Museum pieces on the basis of photographs

The photograph albums were circulated among the Cultural Centre fieldworkers during the last few days of their workshop, which I attended. The photographs excited a great deal of interest and several people provided information about the objects depicted. This has added considerably to knowledge of the origins and significance of the pieces in the collections.

There wasn't sufficient time during the workshop to go through all the photographs to document all of the 580 pieces in the collections. However, I did manage to check all of the woven mats and baskets with Mrs Jean Tarisese of the Vanuatu Cultural Centre. She explained the apparently incorrect provenances of some of the mats; for example, two mats collected in Erromango (A.63021, -2) were most likely made by an Ambae woman whose family was relocated to Erromango by Europeans, and a mat collected in Malekula (A.42469) was almost certainly traded from Ambae.

The tapa cloths were checked with a fieldworker from Erromango, who also corrected provenances. For example, three cloths (A.60480–2) recorded to be from Banks Islands, collected by Archdeacon E.A. Codd and donated in 1970, are definitely not Vanuatuan, as blue-dyed tapas are unique to the Solomon Islands (cf. Neich and

Pendergrast 1997: 128).¹² Codd ran a Melanesian Mission boarding school on Banks Islands but was also for a time Warden of the Teachers' Training College at Seota on Florida Island so he could have obtained the tapas from a Solomon Islands student attending either of those institutions. Three other cloths are definitely not Vanuatuan. Two stencilled tapas (A.37472, 37504), obtained from F. Whitby in 1900 and recorded to be from Havannah Harbour, Efate, are Samoan or early Tongan in type (cf. Neich & Pendergrast 1997: 35, 40) and a third (A.37473) is clearly Tongan (cf. Neich & Pendergrast 1997: 48 bottom). Neich and Pendergrast (1997: 22–23, 155) have noted that tapa cloths often were collected in places far from their geographical or cultural origin, for example when items were moved by trade or when Polynesian mission families were posted to Melanesia.

Five tapas were recognised to be from Erromango in southern Vanuatu – two from the northwest coast (A.56589a, 63020) and three from the southeast coast (A.56589b, 63018, -19). A repeated lozenge design (*nirom*) on the tapas from the northwest was associated with warfare. The designs on the other three were said to represent certain birds (*unkil* and *menuk roya*) and flowers (*niyor*), but the significance of these motifs was not stated.

These tapa cloths from Erromanga, called *nemas-itse*, were used 'as women's clothing and for local barter as well as for carrying babies' (Lawson 1994: 64). Huffman in Bonnemaïson et al (1996: 129–140) provides further information about bark cloth in Vanuatu, how it was made and used, and its sociocultural importance.

The photographs of the clay pots were shown to women at the village of Wusi on Santo, who provided additional information. These included the two pots (A.48082, -3 – *uro-turi* and *uro-vela* respectively) collected and described by Douglas Mawson (Mawson 1957), the one (A.29997) donated to the Museum by Howchin and probably collected by Mawson, one from Rev. William Gray (A.8351) and six from Rev. T. Macmillan (A.8349, 8350, 8352–5), who took over on Tanna when Gray left.

Some information was recorded regarding the circular 'stone money' of Erromango (A.8452) and the crescent-shaped lumps of clam-shell (A.8453–5). I was informed by James Atnelo that

the rings of stone were called *navela*, and were cut from soft limestone then buried for a few years until they hardened up to resemble marble. Speiser (1990: 244–245), who records them as *navilah*, reports that they were not quite like 'money' in that they had no fixed value and were not used in daily trading. I was told they could be used for bridewealth, to pay blood debts and funerary debts, and to make peace. The round ones (*navela*) represent the full moon; the crescent-shaped clam-shell and stone equivalents (*navelong kone*) represent the crescent moon; the former are used only by chiefs and the latter by lower ranks. A *navela* is known by the names of the important women it has been used to 'pay for'.

A canoe model (A.8037) was identified by a workshop participant as coming from Makura in the Shepherd Islands. After I returned to Adelaide, I came across a handwritten list of the collection bought in 1895 from Rev. William Gray. This list includes a model canoe from Tongoa, which is in the Shepherd Islands only 25 kilometres from Makura. This data had not been transferred to the register. Another model canoe in the Gray Collection list is from 'Aneiva', which is undoubtedly Aniwa. This must be A.8039, which appears in the Museum's register as 'Old Collection, New Hebrides'. A photograph of this canoe model was not available for inspection by Cultural Centre fieldworkers to confirm the Aniwa provenance (and by implication that it is part of the Gray Collection), but comparison with Haddon and Hornell's sketch of a canoe from nearby Futuna (1937, Fig. 9) supports this identification.

Photographs of six of the masks in the Museum's collection were shown to a number of men to elicit information about them. Two masks (only one photographed) with the white bird on top (A.7430, 7431) from Rev. Gray in 1895 have been mentioned above. A similar mask, but without a bird, from Rev. F. Whitby in 1900 (A.7429) has been on display for at least 50 years. Although documented as from 'Vote Island' (presumably Vaté, ie Efate), it is from 'Small Nambas' (northeast Malekula) according to informants, and is called *ben'gelo*.¹³ It seems to be the same type of mask as that described by Huffman (in Bonnemaïson et al 1996: 21, Fig. 20) as the 'round head' (*botmoli*) type.

Two masks from Malekula – A.7432 from Rev.

¹² The SA Museum has a similar blue-dyed tapa (A.8270) from Santa Isabel in the Solomons collected by Bishop Cecil Wilson.

¹³ This could be the same as the term I heard, slightly differently, for A.7430 – *bang'lulu*.

F. Whitby, 1900, and A.7758 from the 'Old Collection', 19th century – may be compared to Speiser 1990, Plate 99, Nr 2 and Plate 94, Nr 6 respectively. The only information I could gather was that they were from southern Malekula.

Concern was expressed about the *rom* mask, A.7433, as noted above (but not about A.52465 that appears also to be an Ambrym *rom* mask, nineteenth century, transferred to the South Australian Museum from the Port Adelaide Institute). When I returned to Adelaide I discovered that the former had been given to the Museum around 1906 by Douglas Mawson after he took up a position teaching geology at the University of Adelaide. I read through Mawson's New Hebrides field diaries, which indicate that he travelled through the archipelago by boat and on 12 August 1903 made a few observations, from the deck, at Dip Point (West Ambrym) but there is no mention of going ashore or of collecting the mask there. In one notebook there is a list of things for him to do and on the list is 'Obtain a mask'. It is likely, therefore, that he obtained one in Port Vila from another collector or a trader. In the Mawson archives there is a photograph of him wearing the mask in front of the southeastern corner of the Quadrangle at the University of Sydney during a graduation day charade. Standing on a horse-drawn wagon, his skin blackened, Mawson wears the mask and a grass skirt, and a 'missionary' stands beside a large cooking pot (Pharaoh & Craig 2001).

The South Australian Museum has 17 overmodelled and painted skulls from southern Malekula (A.9756, 11461–75, 12165). Speiser says of northern Vanuatu, 'the head was regarded as the seat of life and the soul, and consequently, after death, the skull was treated with very special reverence' (1990: 319). When a high-ranking man died, his skull was cleaned and overmodelled with a mixture of coconut fibre, clay and fig tree sap to produce a portrait; the head was then painted with the pattern representing the man's rank in the grade system (Speiser 1990: 275). These memorials of the dead were placed on a pole carved with anthropomorphic features (Speiser 1990: Plate 81, Nr 13; Plate 82, Nr 2); or, in the case of the highest-ranking men, the whole body was modelled in plant materials, with the portrait skull set on its neck, and kept in the men's house (Bonnemaison et al 1996, Fig. 243; Speiser 1990: 349, Plate 80, Nr 3). These memorial effigies are called *rambaramp*.

Because of the concerns of Australian Aboriginal people about museums holding

Aboriginal remains, I asked the Director of the Vanuatu Cultural Centre whether the display of portrait skulls was a problem for Vanuatians and he replied that he had never heard such concern expressed. Consistent with this was the response from the Vanuatu Cultural Centre's previous Director when Michael Quinnell of the Queensland Museum asked about whether there would be any objections to displaying the Malekulan *rambaramp* figure in that museum's

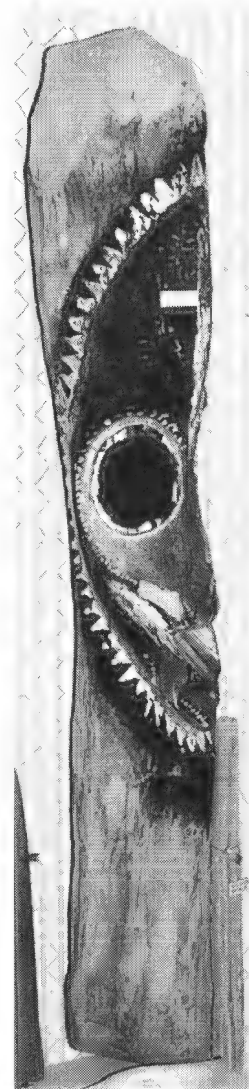


FIGURE 15. Grade figure (A.7448), New Hebrides, 'Old Collection'; collected by Rev. T.W. Leggatt from Barabitam Asing of Sah Sun Bay, south of Aulua, southeast Malekula, and passed on to Rev. W. Gray. Photo: Scott Bradley.

collections (Hamlyn-Harris 1915) and only encouragement was given (M. Quinnell, pers. comm. 25 June 1998).

These results confirm the value of returning to places where artefacts have come from, even a century ago, to recover more information about the objects from the memories of people living today and to check whether exhibition of certain material continues to be permissible.

Acquisitions for future exhibits

I visited specific locations in Vanuatu to purchase objects equivalent to certain pieces in the South Australian Museum's collections. I obtained 21 clay pots from the village of Wusi on Espiritu Santo which are smaller than, but in other ways comparable to, those from around a century ago. I also purchased seven mats and four baskets from Lolowai on the island of Ambae, to compare with the excellent old pieces we have from that island and from Pentecost and Maewo.

Previously we did not have an example of a carved canoe prow and I was able to obtain one. The flute (cf. Bonnemaïson et al 1996: 150–153) and mouth-bow from Chief Pong Randi of Ranon, Ambrym, are comparable to the mouth-bow from Ambrym¹⁴ and the end-blown flute from Malekula mentioned above.

Of considerable interest too is the carved 'black-palm' (tree-fern) grade figure (cf. Bonnemaïson et al 1996, Figs 325, 335) purchased from the dance ground at Fanla from which the slit-drum came. It complements the late 19th century grade figure (A.7448, Fig. 15) of carved and painted wood which almost certainly was collected by Rev. T.W. Leggatt in southeast Malekula and is part of the Gray Collection (see Craig, in press).

These comparative materials formed the basis for a special exhibition, 'Spirits of Vanuatu', in the South Australian Museum's Pacific Gallery commencing March 1998. This exhibition brings



FIGURE 16. James Taimal repainting the slit-drum at the South Australian Museum on the occasion of the Adelaide Festival of Arts, 1998. Photo: Andrew Hughes.

¹⁴ The old handwritten list of items obtained from Rev. William Gray includes '1 Malekula flute' and '1 Harp (Ambrym)'. This list apparently was not seen by the person who registered the mouth-bow in 1941, as the provenance is given as 'Espiritu Santo' and a reference to Edge-Partridge, Series III, p.60 is provided in the Remarks column. This reference is to a British Museum specimen from Espiritu Santo. Speiser (1990) illustrates one, which he calls a Jew's Harp, from Ambrym in Plate 102, Nr 5.

to the attention of the Museum visitor the continuity of tradition in a context of change.¹⁵

Repaint the Drum – the Festival event

James Taimal and Billy Bong had nominated themselves to go to Adelaide to repaint the drum. James had the rights to carve and paint and Billy could assist. The fieldworkers at the workshop had agreed with this proposition.

The cost of passports and visas for the two men, boat travel, meals and accommodation, and an honorarium for each man were met from the project budget. Free air travel was provided for them by Vanair, Airvanuatu and Ansett Airlines.

The repainting event was scheduled for Thursday 12th March. Billy and James arrived in Adelaide Tuesday morning, 10th March. This provided two days to inspect the slit-drum, to look through the Pacific Gallery – especially the Vanuatu exhibits – and become familiar with the venue, to ensure all the necessary equipment and materials were available, to cut a 1.5 metre length of pine for James to demonstrate the carving of a grade figure, and to provide advice about the cooking of the pig and vegetables in a 'ground oven' and the preparation of kava drink from the powdered form they had brought with them from Vanuatu. We were also assisted in the preparation of the food and drink by a number of Melanesian volunteers living in Adelaide.

The carving, painting (Fig. 16) and ground oven were of considerable interest to school students, staff of the Museum and curious passers-by, and elicited many spontaneous and favourable comments. One example was the family from Adelaide's northern suburbs who had come in to the city to see what was happening and stumbled on the event by chance. They commented that it was a pleasant surprise to come across an event which belied the commonly held belief that museums are storehouses of dead things.

A couple of youths with colourful tattoos on their arms and on their shaved heads attracted the favourable interest of James and Billy, who fell into conversation with them. As a result of being treated with respect by people whose culture accepts tattoos as a sign of high status, these

youths offered their help in clearing up the grounds afterwards.

A special guest at the repainting event was Xavier Minniecon, a well-known Adelaide television identity. Minniecon's great grandfather had been 'blackbirded' from Craig Cove to work on the Queensland sugar plantations and had not returned home. Instead he had married a European woman and settled in Australia. Minniecon spoke of his childhood 'on the wrong side of the tracks' and of his determination to make a go of it. He succeeded but felt a gap in his knowledge and experience regarding Vanuatu, as he had never been there. The invitation to be associated with the 'Repainting the Drum' event was for him an opportunity to explore his cultural and genetic roots and he spoke eloquently on behalf of racial and cultural tolerance.

The tables had turned. Previously it was the white people who went among the Melanesians to convince them to live in harmony; now it was the turn of the Melanesians to take that message to the white people.

ACKNOWLEDGMENTS

This project happened because Claire Murray generously donated the slit-drum to the South Australian Museum; and because the Friends of the South Australian Museum provided funding and the then-Director of the South Australian Museum, Dr Christopher Anderson, supported the project as a Festival event. Dr Darrell Tryon (Australian National University) and Ralph Regenvanu and his staff at the Vanuatu Cultural Centre provided information, practical advice and encouragement for the fieldwork component of the project. Several ni-Vanuatu volunteer fieldworkers helped with the logistics and hospitality in the islands. James Taimal and Billy Bong made the Festival event a resounding success. Maria Troiano's research was invaluable and Scott Bradley's photography was crucial to the project. Xavier Minniecon generously gave of his valuable time to help with the feast and dedication of the drum at the Festival. Vanair, AirVanuatu and Ansett Airlines provided fares for James Taimal and Billy Bong, and Helen and Paul Dennet looked after them in Sydney. Several Pacific islanders living in Adelaide volunteered to help cook the pig and vegetables in the ground with hot stones.

¹⁵ The information sheet which accompanies this exhibition may be viewed on the South Australian Museum's website, at <www.samuseum.sa.gov.au/info_sheets.htm>, and click on 'Vanuatu'.

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**TWENTY-FIVE NEW DYTISCIDAE (COLEOPTERA) OF THE GENERA
TJIRTUDESSUS WATTS & HUMPHREYS, NIRRIPIRTI WATTS &
HUMPHREYS AND BIDESSODES REGIMBART FROM UNDERGROUND
WATERS IN AUSTRALIA**

C. H. S. WATTS & W. F. HUMPHREYS

Summary

Twenty-five new species of stygobitic Dytiscidae from inland Western Australia and Central Australia are described: *Tjirtudessus bialveus* sp. nov., *T. cunyuensis* sp. nov., *T. jundeeensis* sp. nov., *T. karalundiensis* sp. nov., *T. macrotarsus* sp. nov., *T. silus* sp. nov., *T. sweetwatersensis* sp. nov., *T. wilunaensis* sp. nov., *T. yuinmeryensis* sp. nov., *Bidessodes limestoneensis* sp. nov., *B. gutteridgei* sp. nov., *Nirripiriti darlotensis* sp. nov., *N. fortisspina* sp. nov., *N. hamoni* sp. nov., *N. killaraensis* sp. nov., *N. macrocephalus* sp. nov., *N. melroseensis* sp. nov., *N. milgunensis* sp. nov., *N. napperbyensis* sp. nov., *N. newhavenensis* sp. nov., *N. pentameres* sp. nov., *N. plutonicensis* sp. nov., *N. stegastos* sp. nov., *N. skaphites* sp. nov. and *N. wedgeensis* sp. nov. The genus *Nirridessus* Watts & Humphreys 1999 is synonymised with *Tjirtudessus* Watts & Humphreys 1999.

TWENTY-FIVE NEW DYTISCIDAE (COLEOPTERA) OF THE GENERA *TJIRTUDESSUS* WATTS & HUMPHREYS, *NIRRIPIRTI* WATTS & HUMPHREYS AND *BIDESSODES* REGIMBART FROM UNDERGROUND WATERS IN AUSTRALIA

CHS WATTS & WF HUMPHREYS

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Twenty-five new species of stygobitic Dytiscidae from inland Western Australia and Central Australia are described: *Tjirtudessus bialveus* sp. nov., *T. cunyuensis* sp. nov., *T. jundeeensis* sp. nov., *T. karalundiensis* sp. nov., *T. macrotarsus* sp. nov., *T. silus* sp. nov., *T. sweetwatersensis* sp. nov., *T. wilunaensis* sp. nov., *T. yuinmeryensis* sp. nov., *Bidessodes limestoneensis* sp. nov., *B. gutteridgei* sp. nov., *Nirripiriti darlotensis* sp. nov., *N. fortisspina* sp. nov., *N. hamoni* sp. nov., *N. killaraensis* sp. nov., *N. macrocephalus* sp. nov., *N. melroseensis* sp. nov., *N. milgunensis* sp. nov., *N. napperbyensis* sp. nov., *N. newhavenensis* sp. nov., *N. pentameres* sp. nov., *N. plutonicensis* sp. nov., *N. stegastos* sp. nov., *N. skaphites* sp. nov. and *N. wedgeensis* sp. nov. The genus *Nirridessus* Watts & Humphreys 1999 is synonymised with *Tjirtudessus* Watts & Humphreys 1999.

This brings the total of stygobitic Dytiscidae described from Australia to 42 species in three genera. Two of the new species are placed in the genus *Bidessodes* Regimbart, representing the first stygobitic members of the genus. Geographically the new species greatly extend the range of stygobitic Dytiscidae in Australia to include Central Australia. As before (see Watts & Humphreys 2001) the stygofauna was found together with a rich stygobitic fauna in those portions of shallow aquifers that ran through areas of calcrete formation.

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This is the fourth paper in what has become a series of papers describing the stygobitic Dytiscidae of Australia (Watts & Humphreys 1999, 2000, 2001). In it we describe the new species found during fieldwork in Western Australia and in the Northern Territory in winter 2001 and discuss the associated stygofauna and chemical profiles of some of the aquifers in which the species were found.

Twenty-five new species are described, which significantly extends both the geographic and taxonomic range of the fauna. A rich fauna has been discovered in aquifers in the Ngalia Basin northwest of Alice Springs in central Australia; and stygobitic members of the genera *Bidessodes* Regimbart (*Bidessini*) and *Copelatus* Erichson (*Copelatinae*) have been discovered as well as numerous new species of the Hydroporine genus *Nirripiriti* Watts & Humphreys, previously known from only one species. The *Copelatus* is the subject of a separate paper that also includes preliminary results of a study of the phylogenetic

relationships between it and other Australian *Copelatus* using DNA sequence data (Balke et al 2003). A similar but separate study has been undertaken on the relationships of the Hydroporine stygobites and potential above-ground relatives (Cooper et al 2002). This study confirms the close relationship between the stygobitic bidessine genera *Nirridessus* Watts & Humphreys and *Tjirtudessus* Watts & Humphreys and the surface genera *Limbodessus* Guignot and *Boongurrus* Larson, as well as the Australian species of *Liodessus* Guignot. The study also suggests that the Hydroporine *Nirripiriti* is close to *Paroster* Sharp as we previously suggested (Watts & Humphreys 2001). This latter placement has been confirmed by Ignacio Ribera (pers. comm.), who included *Nirripiriti hinzeae* Watts & Humphreys in a worldwide study of relationships within the Dytiscidae using sequence data from the mitochondrial genome.

Based on sequence data, two of the new Bidessine species showed little genetic

relationship with either *Tjirtudessus* or *Nirridessus* but grouped somewhat distantly with Australian species of *Bidessodes* Regimbart. Mainly on this evidence they are described here as members of that genus, pending further study and additional specimens and possibly species.

The sequence data is unequivocal in saying what was becoming increasingly apparent morphologically: that any distinction between *Tjirtudessus* and *Nirridessus* is artificial and appears to be based primarily on size. Equally unequivocal is the paraphyletic nature of both these genera together with the Australian *Liodessus* species. The sequence data also includes the genera *Boongurrus* and *Limbodessus* in a very bushy phylogenetic tree. *Allodessus* Guignot is only a little more distant. It is clear that the current taxonomy of this group of genera is untenable. To sort it out will require considerable study, beyond the scope of this paper. We have, however, decided that the existing evidence is too strong not to synonymise the genera *Tjirtudessus* and *Nirridessus*, which we formally do here, *Tjirtudessus* having page priority. We do this in the knowledge that in all probability they will be further synonymised with some or all of the above-ground genera mentioned previously (M. Balke & I. Ribera, pers. comm.).

The bulk of the new species are evenly split numerically between the Bidessine *Tjirtudessus* and the Hydroporine *Nirripierti*. Geographically the two genera appear to have generally different distributions: *Tjirtudessus* more southern and *Nirripierti* more northern. The two *Bidessodes* species are known only from the northern Gascoyne region and will probably also prove to have a northern distribution, as do their above-ground congeners.

As in previous years, the collection includes additional species, known only from either female specimens or partial specimens, and larval specimens of both *Tjirtudessus* and *Nirripierti*. However, these are not reported on at this time, primarily due to lack of suitable material or, in the case of larvae, no firm association with adults. The latter is currently under way utilising genetic typing.

As for the aquifer systems reported in our earlier papers, numerous specimens of Crustacea (bathynellids, harpacticoid and cyclopoid copepods, ostracods and oniscid isopods) and some Oligochaeta and Hydracarina were collected. In addition, some sites in the Northern Territory yielded a diversity of strongly stygomorphic Hydrobiidae (Gastropoda). As before, the beetles

and larger stygofauna were restricted to aquifers in areas of calcrete, as the stygofauna is largely found in the northern parts of the western shield (Poore & Humphreys 1998, submitted; Humphreys 1999a, 2001). As reported in our previous paper (Watts & Humphreys 2001), stygofauna were present both in narrow bore-holes drilled for geological purposes, water pumping or aquifer assessment, and in wide hand-dug wells established for pastoral purposes. The watertable in calcrete is often only 2–3 m below the surface; it is frequently exposed by calcrete quarries used for the purpose of road making or mineral processing, which, being left unfenced, are readily grossly contaminated by stock.

MATERIALS AND METHODS

The collection methods and measurements of physicochemical parameters in the water largely follow those used previously (Watts & Humphreys 2000). However, the use of a Horiba U22 multiparameter instrument in conjunction with previous methods permitted vertical profiles of the physicochemical conditions down some boreholes. Nitrate and Fe^{++} were recorded using test strips in the field (Merck: respectively Merckoquant Nitrate Test 1.0020.001 and Merckoquant Iron Test 1.10004.0001). On analysis, mid-point values were used if a range had been recorded. Hydrogen sulphide was measured, when its odour indicated its presence, using a test kit (Chemetrics: CHEMets sulphide R-9510, range 0–1 and 1–10 ppm).

Abbreviations used:

- BES Prefix for field numbers, WAM Biospeleology.
- SAMA South Australian Museum, Adelaide.
- WAM Western Australian Museum, Perth.
- RN Prefix of water bore and well numbers, Water Resources Division, Department of Lands Planning and Environment in the Northern Territory.
- NTM Northern Territory Museum, Darwin.

SYSTEMATICS

Key to Australian species of stygobitic Dytiscidae

1. — Body length approximately 1.0 mm; legs stout, without swimming-hairs on fore- and mid-legs *Kintinka kurutjutu* Watts and Humphreys

- Body length > 1.0 mm; legs normal, all with swimming-hairs 2
- 2 (1) — Parameres one-segmented; metatibia approximately the same width throughout; without pronotal plicae; (Hydroporini). 28
- Parameres two-segmented; metatibia narrow at base then strongly expanding towards apex; usually with pronotal plicae (Bidessini) 2
- 3 (2) — Mesofemur with spines on hind edge approximately the same strength as those on mesotrochanter; length > 3.0 mm 23
- Mesofemur with spines on hind edge much more robust than those on mesotrochanter; length 1.4–3.6 mm 4
- 4 (3) — Lacking sutural line between abdominal sternites 1 and 2; length 3.2–3.6 mm *Tjirtudessus sweetwatersensis* sp. nov.
- Abdominal sternites 1 and 2 separated by sutural line, at least in inner portion; length 1.3–3.2 mm 5
- 5 (4) — Pronotal plicae strong, well marked, excavated on inside 6
- Pronotal plicae weak, difficult to trace, may be absent, not excavated on inside 10
- 6 (5) — Mesosternum with posterior portion triangular in midline 7
- Mesosternum with posterior portion rounded in midline 8
- 7 (6) — Prosternal process rounded at tip; tip of metatrochanter pointed; lobe on apical segment of paramere short *Tjirtudessus morgani* (Watts and Humphreys)
- Prosternal process pointed at tip; apex of metatrochanter rounded (Fig. 5); lobe on apical portion of paramere long (Fig. 3) *Tjirtudessus bialveus* sp. nov.
- 8 (7) — Head broad, deflexed; metatrochanter round (Fig. 35); setae on mesofemur long (Fig. 34) *Tjirtudessus silus* sp. nov.
- With none of above characters 9
- 9 (8) — Metatarsi with combined length of segments 1 and 2 > combined length of segments 3 to 5; eye remnant present; paramere with long apical lobe *Tjirtudessus pulpa* (Watts and Humphreys)
- Metatarsi with combined length of segments 1 and 2 approximately equal to combined length of segments 3 to 5 (Fig. 6); eye remnant reduced to single short suture; paramere with small apical lobe (Fig. 9) *Tjirtudessus cunyuensis* sp. nov.
- 10 (5) — Elytron with row of large punctures adjacent to suture 22
- Elytron without sutural punctures, other than a few weak ones near base 11
- 11 (10) — Eye remnant reduced to a small oval or triangular structure 19
- Eye remnant reduced to single short suture 12
- 12 (11) — Mesofemur with six to seven spines on hind edge in basal half 13
- Mesofemur with two to four spines on hind edge in basal half 15
- 13 (12) — Protibia thick; protarsi moderately expanded, mesotarsi less so; mesotibia slightly angular *Bidessodes gutteridgei* sp. nov.
- Protibia thin; protarsi and mesotarsi approximately the same size; mesotibia not angular 14
- 14 (13) — Lobe of paramere as wide as rest of apical segment, flat on top, expanded slightly at tip *Tjirtudessus masonensis* (Watts and Humphreys)
- Lobe of paramere shorter than rest of apical segment, rounded on top, tip pointed (Fig. 51) *Tjirtudessus yuinmeryensis* sp. nov.
- 15 (12) — Mesofemur with four spines near base; segments 2 and 3 of antenna similar in length, segment 11 approximately 1.5x segment 10 in length; length > 2.0 mm *Tjirtudessus cueensis* (Watts and Humphreys)
- Mesofemur with two to three strong spines on hind edge near base; segment 2 of antenna large and oval, segment 3 much smaller and thinner than segment 2, segment 11 approaching 2x length of segment 10; length < 2 mm 16

- 16 (15) — Mesofemur with two strong spines on hind edge near base; apical segment of paramere with two finger-like projections *Tjirtudessus pinnaclesensis* (Watts and Humphreys)
- Mesofemur with three strong spines on hind edge near base; apical segment of paramere with one finger-like projection 17
- 17 (16) — Metafemur with three spines grouped together near base *Tjirtudessus fridaywellensis* (Watts and Humphreys)
- Metafemur with two spines near base and one more distant 18
- 18 (17) — Pro- and mesotibia club-shaped; antenna with middle segments enlarged a little on inside *Tjirtudessus hinkleri* (Watts and Humphreys)
- Pro- and mesotibia elongate/triangular in shape; middle segments of antenna virtually symmetrical *Tjirtudessus karalundiensis* sp. nov.
- 19 (11) — Pronotum not constricted at base (Fig. 48); prosternal process reaching or almost reaching mesosternum; 1.4 mm long *Tjirtudessus wilunaensis* sp. nov.
- Pronotum moderately constricted at base (Fig. 18); pronotal process not reaching mesosternum; >1.8 mm long 20
- 20 (19) — Mesofemur with six spines close to base on hind edge *Tjirtudessus bigbellensis* (Watts and Humphreys)
- Mesofemur with three to six spines spread out along basal half of hind edge (Fig. 16) 21
- 21 (20) — Suture line between sternites 1 and 2 well marked; medial lobe of aedeagus parallel-sided, apex not upturned *Tjirtudessus challaensis* (Watts and Humphreys)
- Suture lines between ventrites 1 and 2 weak, usually obsolete in lateral half; medial lobe of aedeagus distinctly narrower in middle, apex upturned (Fig. 13) *Tjirtudessus jundeeensis* sp. nov.
- 22 (10) — Distinct oval eye remnant present *Tjirtudessus windarraensis* (Watts and Humphreys)
- Eye remnant reduced to single short suture *Tjirtudessus lapostaae* (Watts and Humphreys)
- 23 (3) — Mesofemur with spines on hind edge arranged in two comb-like rows along hind edge from base to apex; mesotibia thin, curved *B. limestoneensis* sp. nov.
- Mesofemur spines on hind edge spaced out, not dense and comb-like; mesotibia straight 24
- 24 (23) — Pro- and mesotarsi with segment 1 much more expanded than other segments 25
- Pro- and mesotarsi with segment 1 only moderately expanded compared to other segments 26
- 25 (24) — Antenna with segments 8 to 11 noticeably thinner than others, segment 3 longer than segment 2 *Tjirtudessus magnificus* Watts and Humphreys
- Antenna with segments 8 to 11 not noticeably thinner than others, segment 3 same length as segment 2 (Fig. 30) .. *Tjirtudessus macrotarsus* sp. nov.
- 26 (25) — Pronotum a little narrower than elytra; length 3.5–4.8 mm 27
- Pronotum wider than elytra; length 3.2–3.5 mm *Tjirtudessus eberhardi* Watts and Humphreys
- 27 (26) — Metatrochanters rounded at tip; central lobe of aedeagus straight, tip pointed; with small eye remnant *Tjirtudessus raesideensis* Watts and Humphreys
- Metatrochanters pointed at tip; central lobe of aedeagus twisted, tip knobbed; without eye remnant *Tjirtudessus hahni* Watts and Humphreys
- 28 (27) — From the Northern Territory 29
- From Western Australia 33
- 29 (28) — Head short, very broad, strongly deflexed (Fig. 96); pronotum strongly narrowed at base (Fig. 96); pronotal process anvil-shaped *Nirripiri macrocephalus* sp. nov.
- Head variably shaped, not deflexed, base of pronotum variable, pronotal process 'normally' shaped 30
- 30 (29) — Protarsi with segment 3 not bilobed; pronotum not constricted at base (Fig. 126); antenna thin, segments 1 and 2

- subequal *Nirripirti pentameres* sp. nov.
- Protarsi with segment 3 bilobed; pronotum weakly to moderately constricted at base; antenna thick, segment 2 much broader than segment 1 31
- 31 (30) — 1.8 mm long; body well chitinised ..
..... *Nirripirti napperbyensis* sp. nov.
- 1.2–1.6 mm long; body weakly chitinised 32
- 32 (31) — 1.2 mm long; body only slightly constricted at junction of pronotum and elytra (Fig. 150)
..... *N. wedgeensis* sp. nov.
- 1.5 mm long; body quite strongly constricted at junction of pronotum and elytra (Fig. 120)
..... *Nirripirti newhavenensis* sp. nov.
- 33 (28) — Antenna with segment 2 larger and more oval than segment 1; < 2.5 mm long 38
- Antenna with segment 2 more or less the same shape as segment 1 or smaller; > 2.5 mm long 34
- 34 (33) — Elytron in ventral aspect, with visible portion broad except close to apex ..
..... *Nirripirti stegastos* sp. nov.
- Elytron in ventral aspect, with visible portion narrow except in basal quarter 35
- 35 (34) — Metasternal plate parallel-sided; eight to ten metafemur spines, closely placed, very strong (Fig. 76); metatrochanter long and thin about 4x as long as wide (Fig. 77)
..... *Nirripirti fortisspina* sp. nov.
- Metasternal plate narrowing towards rear; four to eight metafemur spines, weak to moderately strong; metatrochanter moderately elongate 2 to 2.5x as long as wide 36
- 36 (35) — Metasternal plate without wings
..... *Nirripirti plutonicensis* sp. nov.
- Metasternal wings obvious but short 37
- 37 (36) — Metafemur with moderately strong spines; metacoxal plate nearly reaching mesocoxae *Nirripirti hinzeae* Watts and Humphreys
- Metafemur with thin spines (Fig. 70); metacoxal plate at least the width of metafemur from mesocoxae
..... *Nirripirti darlotensis* sp. nov.
- 38 (33) — Elytron with shoulder flared outwards (Fig. 84); tip of metatrochanter pointed (Fig. 83).....*Nirripirti hamoni* sp. nov.
- Elytron with shoulder not flared; metatrochanter squat, tip rounded (Fig. 107) 39
- 39 (38) — Eye remnant absent; metatrochanters large, squat (Fig. 107); hind legs stout; metasternal plate V-shaped; 1.2 mm long
..... *Nirridessus milgunensis* sp. nov.
- Eye remnant represented by a short suture at side of head; metatrochanters elongate; hind legs elongate; metasternal plate U-shaped; 1.5–2.3 mm long 40
- 40 (39) — Head narrower than base of pronotum, body boat-shaped (Fig. 138) 41
- Head broader than base of pronotum, body not boat-shaped (Fig. 102)
..... *Nirripirti melroseensis* sp. nov.
- 41 (40) — 2.1–2.3 mm long; metatrochanter with tip sharply pointed (Fig. 137)
..... *Nirripirti skaphites* sp. nov.
- 1.5–1.9 mm long; metatrochanter with tip rounded (Fig. 89)
..... *Nirripirti killaraensis* sp. nov.

The following species descriptions are grouped in alphabetical order under genus, which are placed in the order *Tjirtudessus*, *Bidessodes*, *Nirripirti*.

Tjirtudessus Watts & Humphreys, 1999

Tjirtudessus bialveus sp. nov.

Types

Holotype: m: 'BES 8118, Cunyu Station, Site 289, mineral exploration bore, 25°46'51"S 120°06'27"E, 24/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM. 32866. Slide mounted.

Paratypes: 17; 9, as for holotype, 6 WAM 32867–32872, 3 SAMA; 3, as for holotype except 'BES 8115', SAMA; 2, as for holotype except 'BES 8601, site 288', WAM 32873–32874; 3, as for holotype except 'BES 8602, site 288', SAMA.

Description (number examined, 18) Figs 1–7

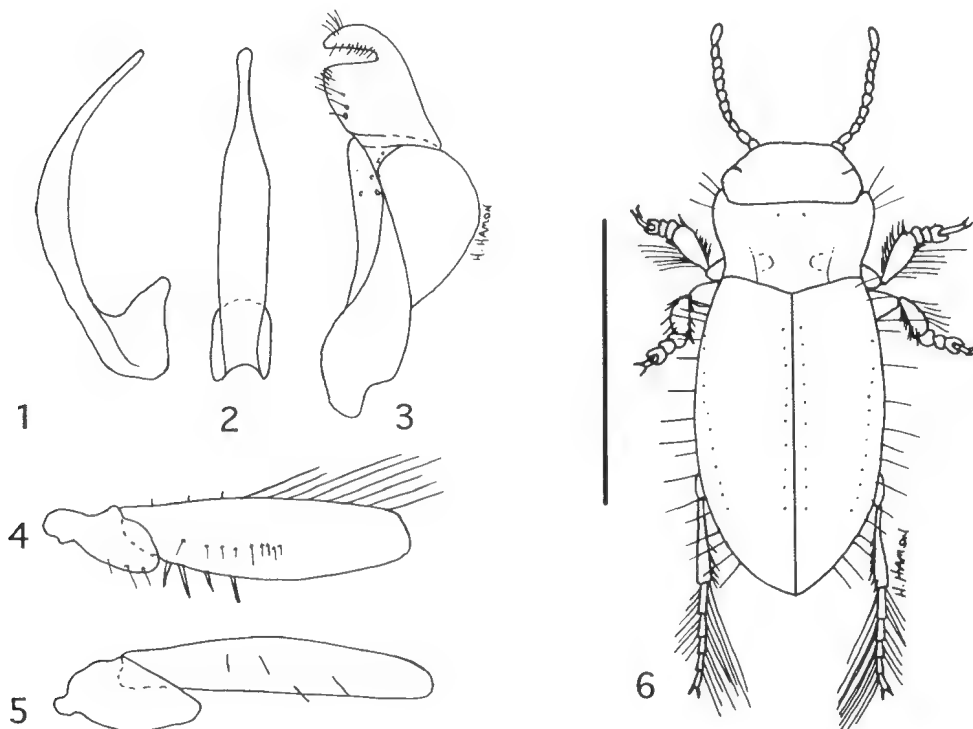
Habitus. Length 1.4–1.9 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-quarter length of elytron.

Head. A little narrower than elytra; smooth, reticulation strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to short dark suture. Antenna stout, basal segment cylindrical, segment 2 oval, segment 3 shorter and narrower and narrowing towards base, segments 4 to 10 subequal, segment 11 about twice as long as segment 10. Maxillary palpus relatively stout, segment 4 about as long as segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

Pronotum. Almost as wide as elytra; anteriolateral angles projecting strongly forward;

base quite strongly narrowed, posterolateral angles acute; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; basal plicae strongly marked, curved, reaching to about halfway along pronotum, deeply excavated inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, strongly reticulate, evenly but sparsely covered with small punctures each with a small seta, row of widely spaced larger punctures close to inner edge; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with a few setiferous micropunctures towards apex and sides. Epipleuron undifferentiated, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.



FIGURES 1–6. *Tjirtudessus bialveus*: 1, lateral view of central lobe of aedeagus; 2, ditto dorsal view; 3, paramere; 4, mesotrochanter and mesofemur; 5 metatrochanter and metafemur; 6, dorsal view. Scale bar represents 1 mm (habitus only).

Ventral surface. Prosternal process relatively broad, strongly narrowed between coxae, almost reaching mesothorax, apical half narrow, almost parallel-sided, tip with long elongate point, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae almost in contact at midline. Metasternum sharply triangular in front in midline; wings short, narrow; triangular in midline behind not reaching halfway to metacoxae. Metacoxal plates large, metacoxal lines weak, moderately widely spaced, reaching to about halfway to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; strongly reticulate.

Legs. Protibia relatively broad, inner edge straight, outer edge bowed, widest near apex where it is about four times its basal width; protarsi moderately expanded, segment 1 round, segment 2 shorter, segment 3 as long as 1 but a bit narrower and deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 1.5 times length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with two spines close together at base and one more distant along hind edge in basal half (Fig. 4); mesotarsi much less expanded than protarsi. Metatrochanter elongate, tip rounded, well separated from femur (Fig. 5); metafemur elongate, lacking spines; metatibia curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 longer than 4, segments 1 and 2 in combination about as long as segments 3 to 5; claws weak.

Male. Pro- and mesotarsi slightly stouter. Median lobe of aedeagus narrow, tip bluntly pointed; paramere broad, apical segment with long, narrow, apical portion well separated from rest of segment (Figs 1–3).

Etymology

Latin. 'Bi' – two, 'alveus' – pit, excavation; alluding to the two very strongly excavated areas on the pronotum.

Remarks

A relatively small species with strong reticulation and deep excavations inwards from the pronotal plicae. These pits partially undercut the plicae and

on their inner edge are ridged for a short distance. The purpose of these structures—which are much deeper than we have seen on any other Dytiscid—are unknown. They do not seem to have any sensory structures associated with them. They are often partially filled with a gritty material.

Tjirtudessus cunyuensis sp. nov.

Types

Holotype: m. 'BES 8156, Cunyu Station, Sweetwaters Well, 25°35'28"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32875.

Paratypes 3: 1, as for holotype, WAM 32876; 2, as for holotype except '8107', SAMA.

Description (number examined, 4) Figs 7–12

Habitus. Length 1.3 mm; narrowly oval, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

Head. Much narrower than elytra; smooth, reticulation strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to a short suture. Antenna stout, basal segment cylindrical, segment 2 oval, segment 3 smaller and narrower, segment 4 slightly smaller than 3, segments 5 to 10 subequal, segment 11 about 1.5 times length of segment 10. Maxillary palpus stout, segment 4 about as long as segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

Pronotum. As wide as elytra; anteriolateral angles projecting strongly forward; base moderately narrowed, posterolateral angles obtuse; smooth, with sparse, very weak punctures each with a short seta and a row of stronger punctures along front margin; basal plicae moderately marked, slightly curved, reaching to about halfway along pronotum, quite strongly excavated inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, moderately covered with small punctures each with a short setae, a short row of larger punctures close to inner edge on disc; a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous setiferous micropunctures towards apex and near suture. Epipleuron undifferentiated, that

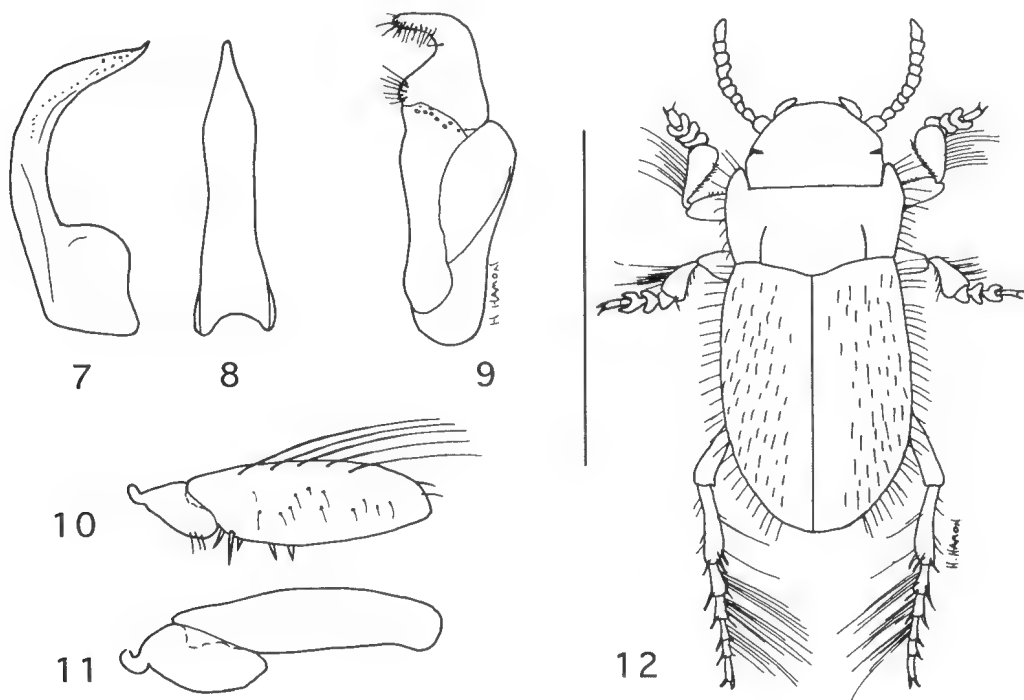
part of elytron visible ventrally narrow except close to base.

Ventral surface. Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half narrow, almost parallel-sided, weakly pointed at apex, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline; wings very narrow; broadly rounded in midline behind; not quite reaching halfway to metacoxae. Metacoxal plates large, metacoxal lines weak, widely spaced, almost parallel, reaching nearly to metasternum; a few small setae-bearing punctures towards midline; reticulation moderate, meshes uneven; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively broad, inner and outer edges straight, widest past apex where it is about

four times its basal width; protarsi expanded, segment 1 broad, segment 2 as broad as and about one-third length of segment 1, segment 3 as long as 1 and as broad, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of four to five relatively weak spines unevenly spaced along hind edge in basal half (Fig. 10); mesotarsi less expanded than protarsi. Metatrochanter tip pointed, weakly separated from femur at tip (Fig. 11); metafemur relatively broad, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male. Median lobe of aedeagus relatively broad, tip sharply pointed; paramere broad, apical segment narrow, apical portion well separated from rest of segment (Figs 7-9).



FIGURES 7-12. *Tjirtudessus cunyuensis*: 7, lateral view of central lobe of aedeagus; 8, ditto dorsal view; 9, paramere; 10, mesotrochanter and mesofemur; 11 metatrochanter and metafemur; 12, dorsal view. Scale bar represents 1 mm (habitus only).

Etymology

Named after the pastoral station on which it was collected.

Remarks

A relatively small species with stout antennae and legs and well-marked pronotal plicae. Resembles *T. pulpa*, from which it differs in lack of oval eye remnant and short apical lobe to the paramere.

Tjirtudessus jundeeensis sp. nov.*Types*

Holotype: m. "BES 6475, Jundee Station, bore at Jundee Homestead, 26°21'12"S; 120°38'31"E, 11/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper", WAM 32877. Slide mounted.

Paratypes: 27; 1, as for holotype, WAM 32878; 17, 'BES 6581, Jundee Station. bore JSP 6, South Hill Well BF, Jundee Mine, 26°16'58"S 120°40'37"E, 11/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', 2 WAM 32879–32880, 15 SAMA; 1, as for holotype except 'BES 6582' and 'JE149', WAM 32881; 1, as for holotype except 'BES 6590' and 'JE124', WAM 32882; 3, as for holotype except 'BES 6594' and 'JE112', 3 WAM 32883–32885; 3, as for holotype except 'BES 6597' and 'JE150', 2 WAM 32886–32887, 1 SAMA; 2, as for holotype except 'BES 6603' and 'JE125', WAM 32888–32889.

Description (number examined, 28) Figs 13–18

Habitus. Length 2.3–2.6 mm; relatively flat, moderately constricted at base of pronotum; uniformly very light testaceous; hindwing reduced, about three-quarters length of elytron.

Head. Narrower than elytra; smooth, reticulation very weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to narrowly oval structure. Antenna relatively stout, segments 1 and 2 cylindrical, segment 3 slightly shorter than segment 2 narrowing towards base, segments 4 to 10 subequal but becoming progressively slightly broader, segment 11 1.5 times longer and slightly thinner than segment 10. Maxillary palpus moderately elongate, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

Pronotum. As wide as elytra; anteriolateral angles projecting strongly forward; base quite

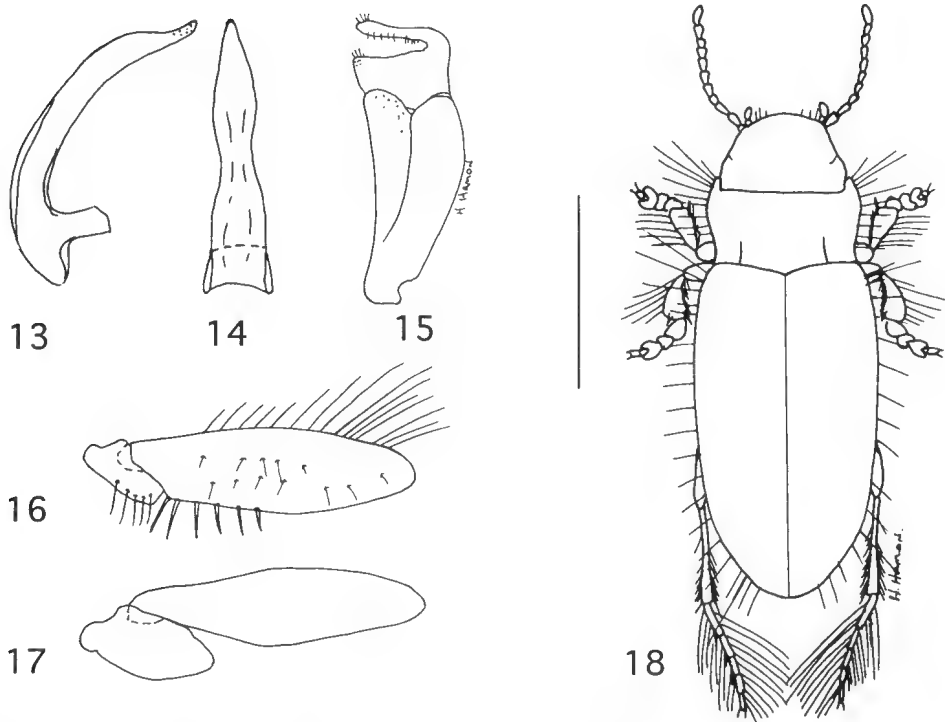
strongly narrowed, posterolateral angles acute; smooth with sparse, very weak punctures and a row of stronger punctures along front margin; basal plicae weakly marked, converging slightly towards front, reaching to about halfway along pronotum; with row of long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; elongate, almost parallel-sided, smooth, sparsely covered with very small punctures; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside with a few scattered setiferous micropunctures towards apex. Epipleuron weakly differentiated, that part of elytron visible ventrally moderately broad in anterior fifth, thin over rest of elytron.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half relatively broad, almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines obsolete; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively narrow, triangular, widest at apex where it is about 2.5 times its basal width; protarsi moderately expanded, segment 1 as wide as long, segment 2 about as wide and about one-half length of segment 1, segment 3 as long and wide as first, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with very dense covering of adhesive setae; claws one-half length of segment 5. Mesotrochanter elongate with a few fine setae on inner edge; mesofemur with row of five to six moderately strong setae along hind edge in basal half (Fig. 16); mesotarsi similar to protarsi. Metatrochanter tip rounded, well separated from metafemur (Fig. 17); metafemur thin, elongate, lacking spines; metatibia thin, strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 longer than segment 4, in combination segments 1 and 2 about as long as others; claws equal, weak.

Male. Little external difference between median



FIGURES 13–18. *Tjirtudessus jundeeensis*: 13, lateral view of central lobe of aedeagus; 14, ditto dorsal view; 15, paramere; 16, mesotrochanter and mesofemur; 17 metatrochanter and metafemur; 18, dorsal view. Scale bar represents 1 mm (habitus only).

lobe of aedeagus varying slightly in width along shaft, narrowing towards apex, bluntly pointed; parameres broad, apical segment relatively broad, short, with long, narrow, apical lobe well separated from rest of segment (Figs 13–15).

Etymology

Named after the pastoral station on which it was collected.

Remarks

A moderate sized, narrowly elongate, weakly chitinised species with the tip of the metatrochanter well separated from the femur, and weak pronotal plicae. Morphologically close to *T. challaensis* but with the suture line between first and second ventrites much less obvious and the apical lobe of the paramere well separated from the rest of the segment.

Tjirtudessus karalundiensis sp. nov.

Types

Holotype: m: 'Karatundi, unlined well, 26°08'S

118°41'E, 28/5/2001. Col. C.H.S. & G.A. Watts'. Field number 339-1. WAM 32890. Slide mounted.

Paratypes: 14, as for holotype 5, WAM 32891–32895, 9 SAMA.

Description (number examined, 15) Figs 19–24.

Habitus. Length 1.3–1.4 mm; relatively flat, moderately constricted at junction of pronotum/elytra; elytra relatively broad, uniformly light testaceous; hindwing reduced, about length of elytron.

Head. Narrower than elytra; smooth, reticulation moderate, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to short suture. Antenna relatively stout, segment 1 cylindrical, segment 2 oval, segment 3 about one-half length segment 2 and two-thirds width, narrowing towards base, segment 4 bit shorter and narrower than segment 3, segments 5 to 10 subequal and a little wider than 3 and 4, segment 11 about twice length of segment 10. Maxillary palpus elongate, segment 4 a little shorter than

segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

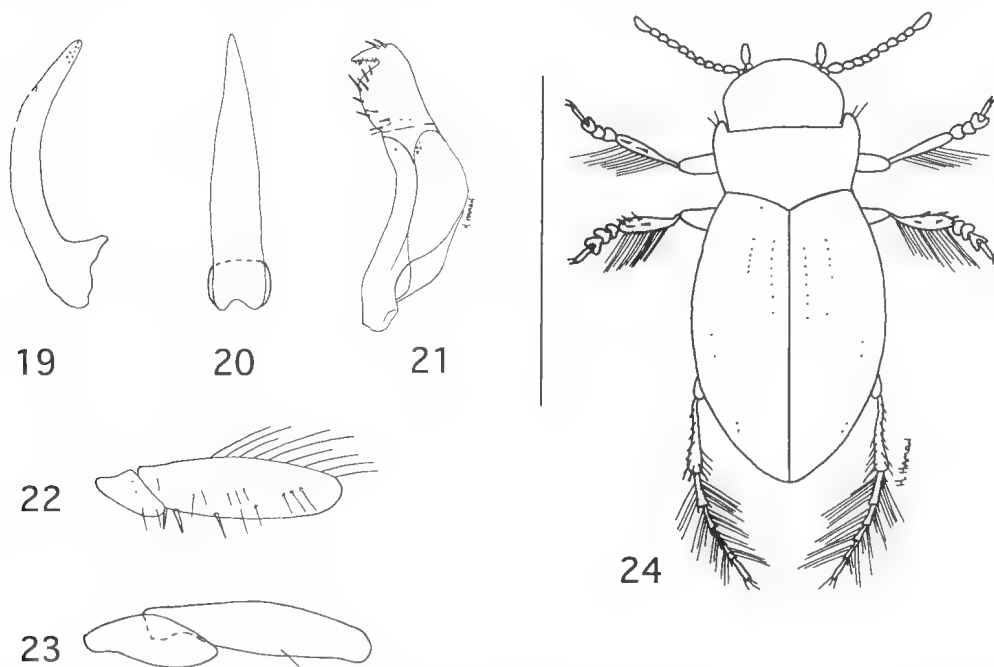
Pronotum. Narrower than elytra; anteriolateral angles projecting strongly forward; base moderately constricted, posterolateral angles acute; smooth, moderately reticulate, with sparse, very weak punctures and a row of stronger punctures along front margin, sparse covering of short setae; basal plicae absent, straight; with row of long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; oval, widest in middle, smooth, moderately reticulate, moderately densely covered with short setae, sparsely covered with very small punctures, row of widely spaced larger punctures close to inner edge; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous setiferous micropunctures towards apex. Epipleuron only weakly differentiated; that portion of elytron visible ventrally narrow in anterior fifth, virtually absent along rest of elytron.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half relatively broad, almost

parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings very narrow; posterior portion relatively narrow, rounded at apex. Metacoxal plates large, heart-shaped in combination, metacoxal lines absent, surface reticulate, a few small setae-bearing punctures towards midline; closely adpressed to abdominal ventrite 1. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, moderately rugose, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia triangular, widest at apex where it is about three times its basal width; protarsi moderately expanded, segment 1 about twice as long as wide, segment 2 a little broader and about one-half length of segment 1, segment 3 as long as first slightly broader, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with adhesive setae; claws short and simple. Mesotrochanter elongate with a few setae on inner edge; mesofemur with row of three relatively



FIGURES 19–24. *Tjirtudessus karalundiensis*: 19, lateral view of central lobe of aedeagus; 20, ditto dorsal view; 21, paramere; 22, mesotrochanter and mesofemur; 23 metatrochanter and metafemur; 24, dorsal view. Scale bar represents 1 mm (habitus only).

strong setae along hind edge in basal half (Fig. 22); mesotarsi about one-half breadth of protarsi. Metatrochanter tip pointed, (Fig. 23); metafemur elongate, lacking spines; metatibia moderately curved, widening towards apex; metatarsi elongate, segment 1 longest, other segments approximately equal in length, in combination segments 1 and 2 about as long as others; claws weak.

Male. No external differences between the sexes. Median lobe of aedeagus parallel-sided narrowing towards apex, tip bluntly pointed; paramere broad, apical segment relatively long, with narrow apical lobe moderately separated from rest of segment, about one-half width of segment (Figs 19–21).

Etymology

Named after type locality.

Remarks

A small elongate/oval species moderately constricted at the base of the pronotum and with three stout spines on the mesofemur. It most closely resembles *T. hinkleri*, from which it is most easily separated by the smaller apical lobe on the paramere and the symmetrical rather than slightly asymmetrical middle antennal segments.

Tjirtudessus macrotarsus sp. nov.

Types

Holotype: m: 'BES 8118, Cunyu Station, Site 289, mineral exploration bore, 25°46'51"S 120°06'27"E, 24/8/2001 col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32896. Slide mounted.

Paratypes: 7: 5, as for holotype, 3 WAM 32897–32899, 2 SAMA; 2, as for holotype except 'BES 8115' SAMA.

Description (number examined, 8) Figs 25–30

Habitus. Length 4.2–4.4 mm; elongate, relatively flat, slightly depressed in midline, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

Head. A little narrower than elytra; slightly deflexed; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to a short suture. Antenna thin, segments 1 and 2 cylindrical, segments 3 and 4 as long as segment 2 but narrower and slightly narrowing towards base, segments 5 to 9 subequal but

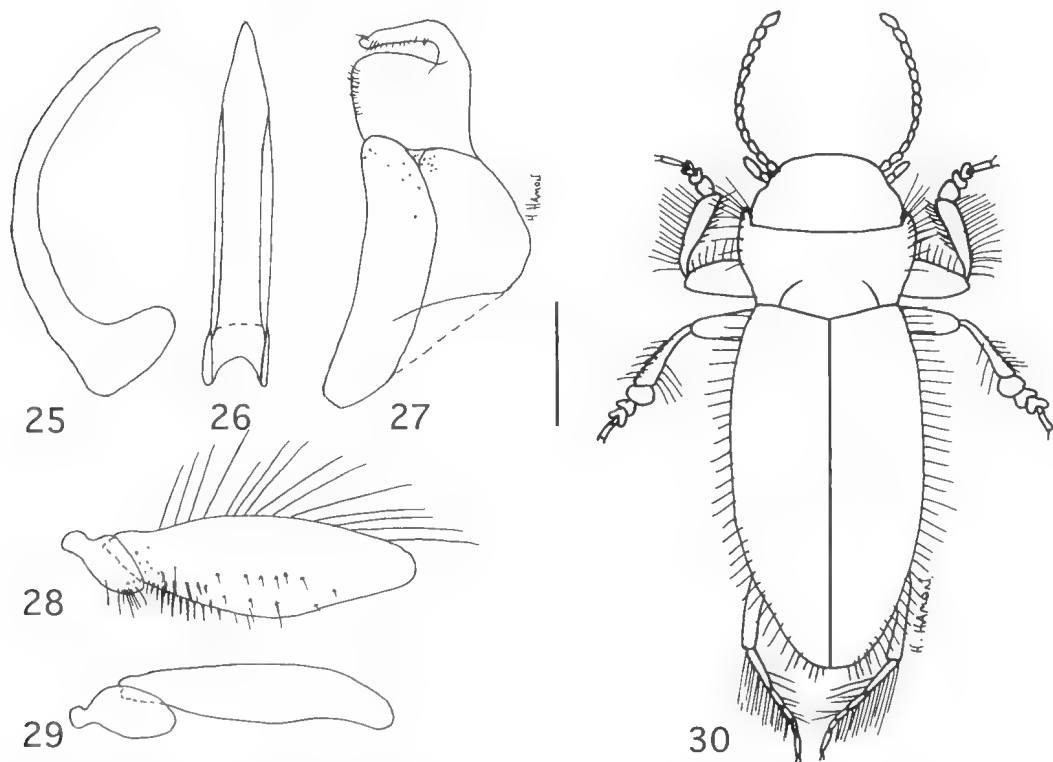
becoming progressively shorter, each weakly expanded inwards near apex, segment 10 cylindrical, segment 11 about 1.5 times as long as segment 10. Maxillary palpus elongate, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

Pronotum. Short, almost as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute, overlapping elytra; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin, reticulation weak; basal plicae moderately marked, straight, short, reaching to about one-third way along pronotum, slightly excavated inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, a loose row of larger punctures with long setae near centre of each elytron, a moderate number of additional large punctures with long setae, more frequent towards sides. Underside of elytron with a few setiferous micropunctures near base and some on epipleuron near base. Epipleuron very weakly differentiated, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

Ventral surface. Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half broad, triangular, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum triangular in front in midline; wings very narrow; broadly rounded in midline behind; reaching well past halfway to metacoxae. Metacoxal plates large, metacoxal lines very weak, relatively close, reaching to about halfway to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; reticulation very weak.

Legs. Protibia relatively narrow, inner edge straight, outer edge bowed, widest past middle where it is about three times its basal width; protarsi expanded, segment 1 large broadly rounded, segment 2 much narrower, about one-third length of segment 1, segment 3 about half



FIGURES 25–30. *Tjirtudessus macrotarsus*: 25, lateral view of central lobe of aedeagus; 26, ditto dorsal view; 27, paramere; 28, mesotrochanter and mesofemur; 29 metatrochanter and metafemur; 30, dorsal view. Scale bar represents 1 mm (habitus only).

as long as segment 1, narrower than segment 2, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short, relatively robust. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of 10 to 15 weak spines along hind edge in basal half only slightly stronger than the setae on mesotrochanter (Fig. 28); mesotarsi a little less expanded than protarsi. Metatrochanter relatively small, broadly oval, tip rounded (Fig. 29); metafemur thin, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 much longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male. No external differences between the sexes. Median lobe of aedeagus variable in width along shaft, tip bluntly pointed; paramere broad, apical segment relatively large with long, narrow,

apical lobe moderately separated from rest of segment (Figs 25–27).

Etymology

Alluding to the large basal tarsal segment of the pro- and mesotarsi.

Remarks

A large narrow species recognised by the large basal segment of the pro- and mesotarsi, thin antenna and broadly oval metatrochanters.

Tjirtudessus silus sp. nov.

Types

Holotype: m: 'BES 8107, Cunyu Station, Sweetwaters Well, 25°35'38"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32900. Slide mounted.

Paratypes: 25; 10, 'BES 8107, Cunyu Station, Sweetwaters Well, 25°35'38"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic &

J.M. Waldock', 5 WAM 32901–32905, 5 SAMA; 4, ditto except 'BES 8156', WAM 32906–32909; 11, ditto except 'BES 8589', 5 WAM 32910–32914, 6 SAMA.

Description (number examined, 26) Figs 31–36

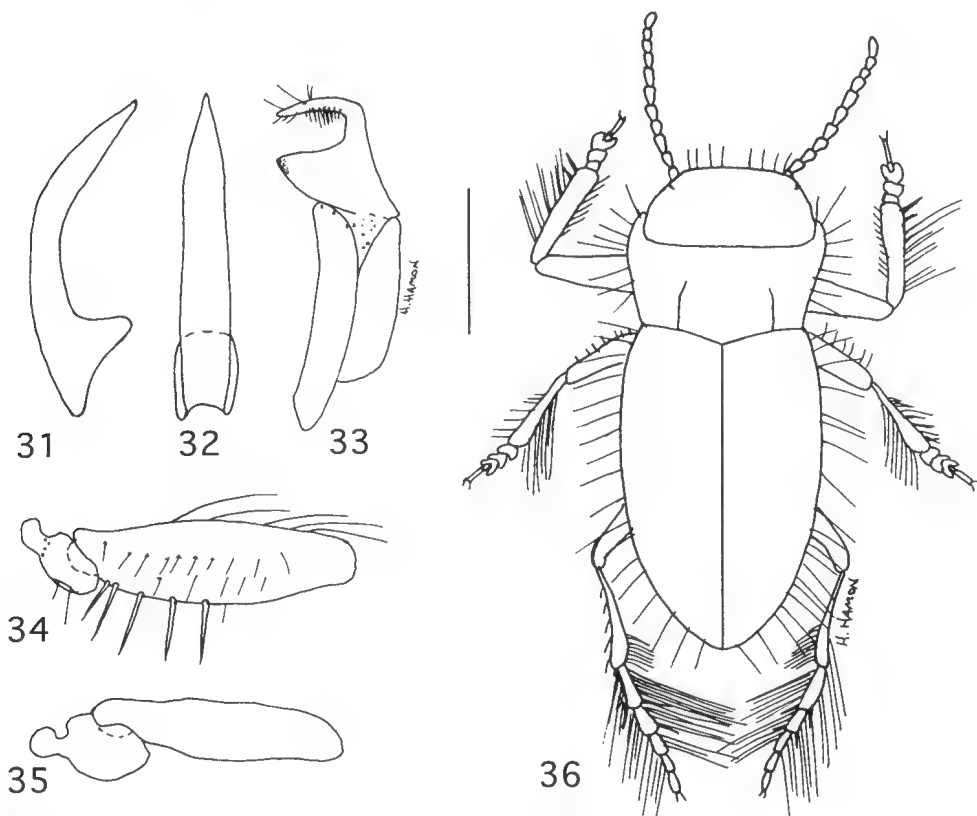
Habitus. Length 1.7–2.1 mm; relatively flat, head somewhat deflexed, weakly constricted at junction of pronotum/elytra; uniformly very light testaceous; hindwing vestigial, about one-third length of elytron.

Head. Short, about as wide as elytra, bulbous in lateral view; smooth, reticulation moderate, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to small triangular or oval structure on ventral surface near edge. Antenna relatively stout, segments 1 and 2 cylindrical, segment 3 shorter than segment 2, segments 4 to 10 subequal, slightly expanded at their apices on inside, more so on middle segments, segment 11 a

bit longer and narrower than segment 10. Maxillary palpus elongate, segment 4 longer than segments 1 to 3 combined, oblique row of long setae on outer side.

Pronotum. Short, as wide as or a bit wider than elytra; anteriolateral angles projecting strongly forward; base weakly constricted, posterolateral angles obtuse; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; reticulation very weak; basal plicae well marked, slightly sinuate, reaching to about halfway along pronotum, very strongly excavated inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides, underside of elytron with a few setiferous micropunctures towards



FIGURES 31–36. *Tjirtudessus silus*: 31, lateral view of central lobe of aedeagus; 32, ditto dorsal view; 33, paramere; 34, mesotrochanter and mesofemur; 35, metatrochanter and metafemur; 36, dorsal view. Scale bar represents 1 mm (habitus only).

apex and on epipleuron near base. Reticulation weak. Epipleuron undifferentiated, that portion of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

Ventral surface. Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half narrow, weakly triangular, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, moderately widely spaced, reaching about halfway to metasternum, subparallel; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines indistinct towards midline, absent laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; weakly reticulate.

Legs. Protibia elongate, narrow, inner edge straight, outer edge weakly bowed, widest near apex where it is about three times its basal width; protarsi moderately expanded, segment 1 rounded, segment 2 about one-half length of segment 1, segment 3 as long as segment 1 and very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of five to six relatively long spines along hind edge in basal half (Fig. 34); mesotarsi much less expanded than protarsi. Metatrochanter short (Fig. 35); metafemur thin, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, relatively robust, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male. Little external difference between the sexes. Median lobe of aedeagus variable in width along shaft, tip bluntly pointed; paramere broad, apical segment with long, narrow, apical portion well separated from rest of segment (Figs 31–33).

Etymology

Latin. 'Silus' – pug-nosed.

Remarks

A medium sized species easily recognised by its

broad pug-nosed head as well as thin legs, round metatrochanters, strong pronotal plicae and long spines on the mesofemurs.

Tjirtudessus sweetwatersensis sp. nov.

Types

Holotype: m: 'BES 8107, Cunyu Station, Sweetwaters Well, 25°35'38"S 120°22'21"E, 23/8/2001, col. W.F. Humphreys, T. Karanovic and J.M. Waldock', WAM 32915. Slide mounted.

Paratypes: 11; 6, as for holotype, SAMA; 2, as for holotype except 'BES 8156', WAM 32916–32917; 3, as for holotype except 'BES 8589', WAM 32918–32920.

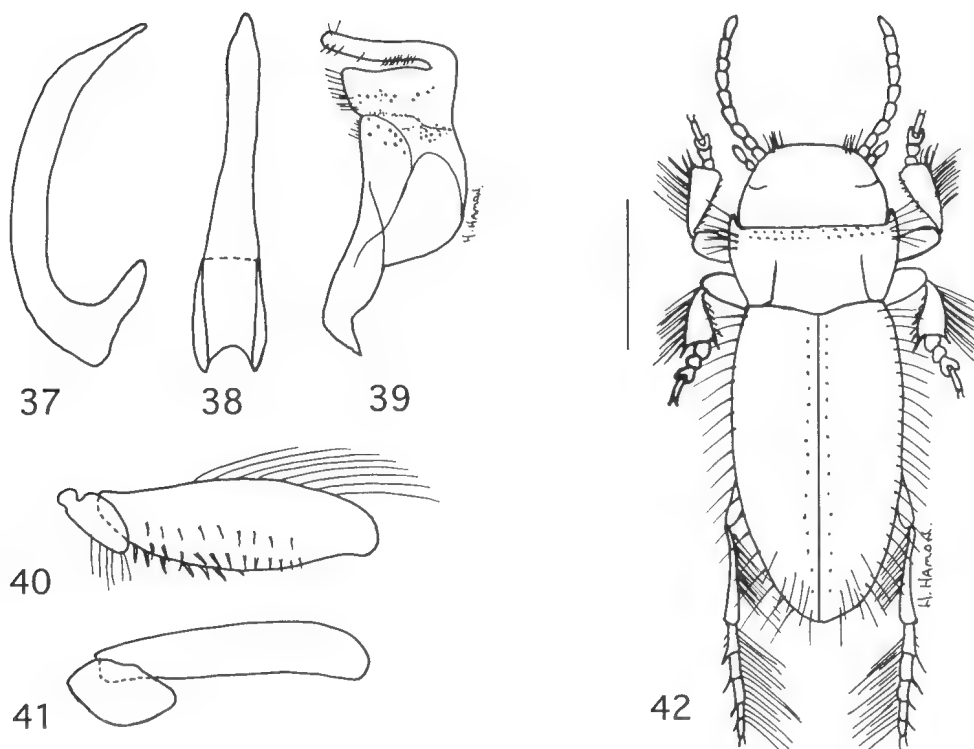
Description (number examined, 12) Figs 37–42

Habitus. Length 3.2–3.6 mm; elongate, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

Head. About as wide as elytra; smooth, reticulation moderate, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to narrowly oval structure on underside of head behind antennal bases. Antenna relatively stout, segments 1 and 2 cylindrical, segments 3 and 4 similar, a little shorter than segment 2, segments 5 to 10 subequal, narrower at their bases, segment 11 a bit longer and narrower than segment 10. Maxillary palpus elongate, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

Pronotum. As wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute, slightly overlapping elytra; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; basal plicae moderately marked, slanted inwards, reaching to about halfway along pronotum, with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures, row of widely spaced larger punctures close to inner edge; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous setiferous micropunctures towards apex and near suture. Epipleuron undifferentiated, that part of elytron visible



FIGURES 37–42. *Tjirtudessus sweetwatersensis*: 37, lateral view of central lobe of aedeagus; 38, ditto dorsal view; 39, paramere; 40, mesotrochanter and mesofemur; 41, metatrochanter and metafemur; 42, dorsal view. Scale bar represents 1 mm (habitus only).

ventrally quite broad in anterior quarter, virtually absent along rest of elytra.

Ventral surface. Prosternal process rather narrow, strongly narrowed between coxae, not reaching mesothorax, apical half almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, moderately widely spaced, reaching to about halfway to metasternum, almost parallel; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines absent, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; moderately reticulate.

Legs. Protibia relatively elongate, inner edge straight, outer edge bowed, widest past middle where it is about three times its basal width; protarsi weakly expanded, segment 1 broad,

segment 2 about one-third length of segment 1, segment 3 a little longer than segment 2 and deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with row of seven to nine relatively weak spines along hind edge in basal half (Fig. 40); mesotarsi a little less expanded than protarsi. Metatrochanter tip bluntly pointed (Fig. 41); metafemur elongate, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male. No external differences between the sexes. Median lobe of aedeagus a little variable in width along shaft, tip bluntly pointed; paramere broad, apical segment relatively short, with long, narrow, apical portion close to rest of segment (Figs 37–39).

Etymology

Named after the type locality.

Remarks

A relatively large species recognised by the lack of a sutural line between the first and second ventrites, the similarity of the basal two antennal segments and a relatively large oval eye remnant.

Tjirtudessus wilunaensis sp. nov.*Types*

Holotype: m: 'BES 6433, Wiluna Gold, Lake Violet Borefield bore XPIOB, 26°40'30"S 120°13'55"E, 9/5/200, col. W.F. Humphreys, C.H.S. Watts & S. Cooper'. WAM 32921. Slide mounted.

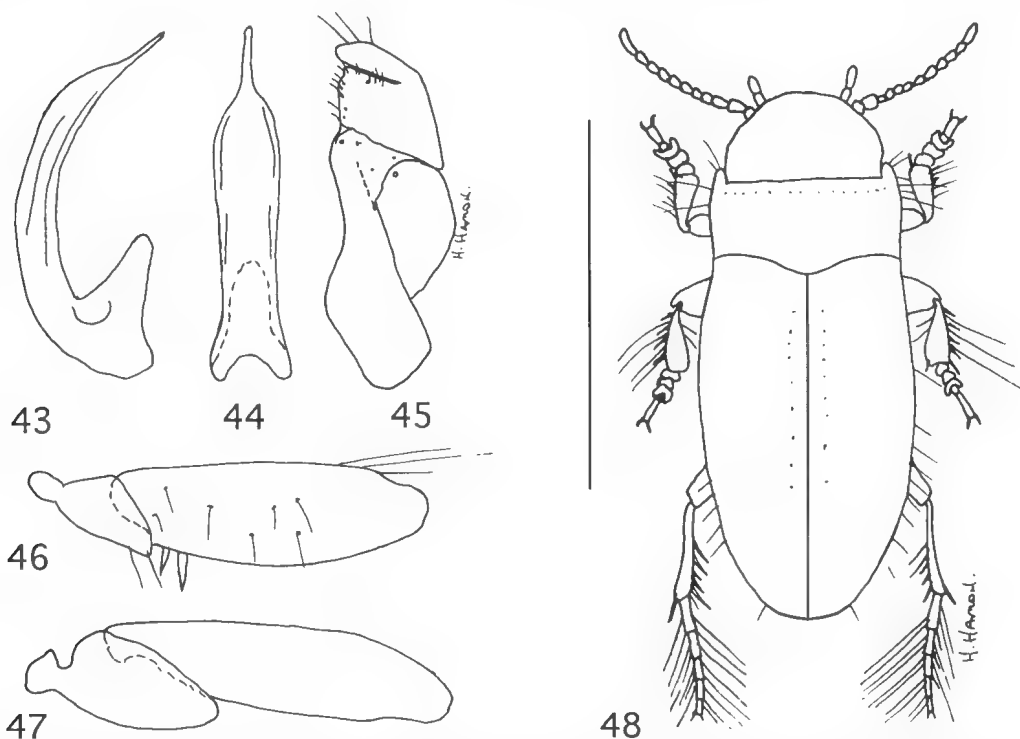
Paratype: 1, 'BES 5640, Millbillillie Pastoral station. Bore nr. Bubble Well, 26°33'39"S 120°02'27"E, 8/5/2001 coll. W.F. Humphreys, C.H.S. Watts & S. Cooper', SAMA. There is some doubt regarding this locality: the field notes suggest that it could have come from the same locality as the holotype.

Description (number examined, 2) Figs 43–48

Habitus. Length 1.4 mm; relatively flat, very weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing reduced, about three-quarters length of elytron.

Head. Slightly narrower than elytra; smooth, reticulation weak, punctures sparse, very small; subparallel in posterior half, bulging just behind eye remnant; eye remnant reduced to a small triangular structure. Antenna stout, segment 1 large, cylindrical, segment 2 larger, barrel-shaped, segment 3 a bit shorter, about one-half as wide as long narrowing towards base, segment 4 bit narrower and one-half the length of segment 3, segments 5 to 10 subequal, segment 11 twice length of segment 10, thinner. Maxillary palpus stout, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

Pronotum. About as wide as elytra; anteriolateral angles projecting strongly forward; base very slightly narrowed, posterolateral angles obtuse; smooth, with sparse, very weak punctures and a row of stronger punctures along front



FIGURES 43–48. *Tjirtudessus wilunaensis*: 43, lateral view of central lobe of aedeagus; 44, ditto dorsal view; 45, paramere; 46, mesotrochanter and mesofemur; 47, metatrochanter and metafemur; 48 dorsal view. Scale bar represents 1 mm (habitus only).

margin; basal plicae if present not visible on the two mounted specimens; with row of long setae laterally, denser towards front.

Elytra. Possibly fused, lacking inner ridges; elongate, widest in front of middle, smooth, covered with very small punctures, sparse row of large punctures near suture; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron undifferentiated, that portion of elytra visible ventrally relatively broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

Ventral surface. Prosternal process strongly narrowed between coxae, almost reaching mesothorax, apical half relatively broad, triangular with blunt tip, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae slightly separate. Metasternum sharply triangular in front in midline; wings very narrow; slightly pointed in midline behind. Metacoxal plates large, metacoxal lines obsolete; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia triangular, widest at apex where it is about three times its basal width; protarsi expanded, segments 1 to 3 broad, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with a covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few setae on inner edge; mesofemur elongate/oval with two strong spines near base on hind edge (Fig. 46); mesotarsi much less expanded than protarsi. Metatrochanter tip elongate/oval (Fig. 47); metafemur relatively broad, lacking spines; metatibia moderately curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male. No external differences between the sexes. Median lobe of aedeagus relatively broad, sharply narrowing to apex, tip bluntly pointed; paramere broad, apical segment moderately long, with long, club-shaped apical lobe tending to overlap rest of segment, slightly wider than adjacent part of apical segment (Figs 43–45).

Etymology

Named after the type locality.

Remarks

A very small almost parallel-sided species with almost no pronotal constriction and a short fourth segment of the antenna which is only a little more than one-half the length of the third. So far unique among the Australian dytiscid stygofauna in having the tip of the pronotal process meeting, or almost meeting, the forward extension of the mesosternum, slightly separating the mesocoxae.

The eye remnant is little more than a short bifurcation of the more usual suture line on the ventral surface. In the key it has been scored as present. The species will run to *T. pinnaclesensis* if it is considered absent, from which the separate mesocoxae and lack of pronotal constriction will separate it.

Tjirtudessus yuinmeryensis sp. nov

Types

Holotype: m: 'BES 6654, Yuinmery Station, New Well, 28°32'62"S 119°05'28"E, 15/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32922. Slide mounted.

Paratypes: 53; 7, as for holotype, WAM 32923–32929; 46, as for holotype except 'BES 6653', 20 WAM 32930–32949, 26 SAMA; 1, 'BES 8063, Yuinmery Station, Nine Mile Well, 28°32'35"S 119°08'00"E, 15/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32950.

Description (number examined, 54) Figs 49–54

Habitus. Length 1.6–2.0 mm; relatively flat, narrow. Moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

Head. Narrower than elytra; smooth, reticulation very weak, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to single suture tending to widen or thicken ventrally. Antenna relatively stout, segment 1 cylindrical, segment 2 barrel-shaped, segment 3 a little shorter and much narrower and narrowing towards base, segment 4 shorter than segment 3, segments 5 to 10 subequal, segment 11 about twice length of segment 10. Maxillary palpus elongate, segment 4 about length of segments 1 to

3 combined, oblique row of long setae on outer side, tip truncated.

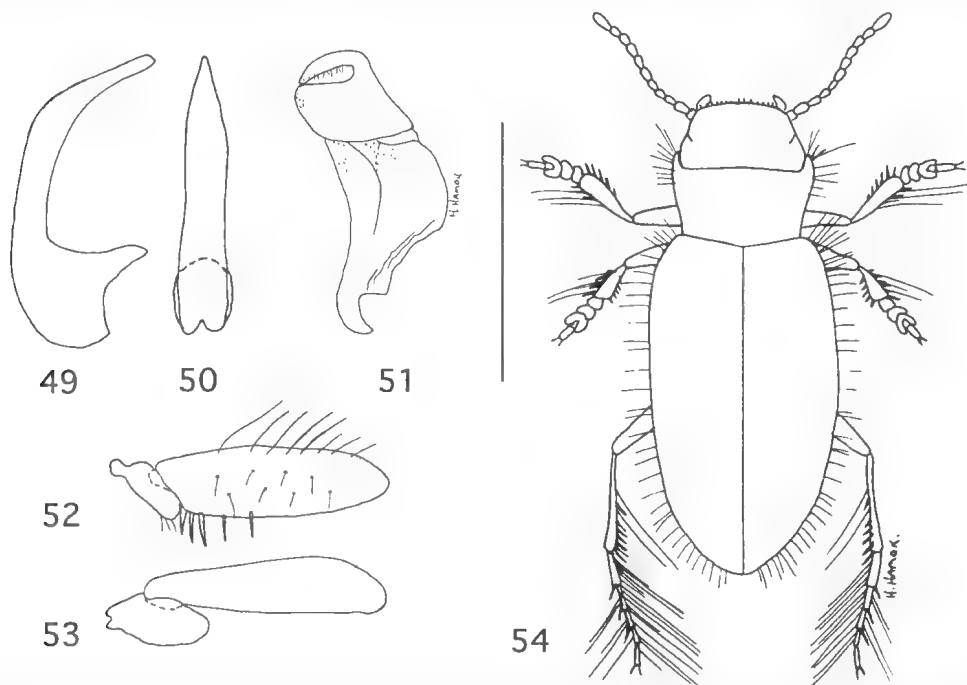
Pronotum. Almost as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles acute; smooth, with sparse, very weak punctures; basal plicae moderately marked, straight, reaching to about halfway along pronotum, slightly excavated inwards; with row of long setae laterally, denser towards front.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with very small punctures; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with a few setiferous micropunctures near base and on epipleuron near base. Epipleuron not differentiated, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half moderately broad, almost parallel-sided, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum

sharply triangular in front in midline; wings very narrow; rounded in midline behind. Metacoxal plates large, metacoxal lines moderately widely spaced, reaching to about halfway to metasternum, diverging slightly towards front; a few small setae-bearing punctures towards midline; closely adpressed to first abdominal ventrite. First and second ventrites fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia relatively broad, inner edge straight, outer edge bowed, widest near apex where it is about four times its basal width; protarsi weakly expanded, segment 1 subrectangular, segment 2 as wide and about one-half length of segment 1, segment 3 as long as segment 1 but a little narrower and very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate/oval with a few setae near apex; mesofemur with row of five to six relatively strong spines along hind edge in basal half (Fig. 52); mesotarsi similar to protarsi.



FIGURES 49–54. *Tjirtudessus yuinmeryensis*: 49, lateral view of central lobe of aedeagus; 50, ditto dorsal view; 51, paramere; 52, mesotrochanter and mesofemur; 53, metatrochanter and metafemur; 54 dorsal view. Scale bar represents 1 mm (habitus only).

Metatrochanter tip rounded (Fig. 53); metafemur elongate, widest beyond middle, lacking spines; metatibia thin, strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male. Little external difference between the sexes. Median lobe of aedeagus relatively narrow and narrowing to blunt point; paramere broad, apical segment with long, narrow, apical lobe well separated from rest of segment except near tip (Figs 49–51).

Etymology

Named after the station property on which the species was collected.

Remarks

A relatively small, pale, narrowly elongate species with five to six relatively strong mesofemoral spines. Closely resembles *T. masonensis*, from which it can only be separated by a slightly shorter apical lobe to the paramere and by DNA sequencing.

Bidessodes Regimbart

Bidessodes gutteridgei sp. nov.

Types

Holotype: m.: 'BES 8651, Three Rivers Station, Limestone Well, 25°16'59"S 119°10'33"E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32952. Slide mounted.

Paratypes: 18; 2, 'BES 8605, Three Rivers Station, bore MB4 Plutonic Borefield, 25°16'43"S 119°11'00"E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', 1 WAM 32953, 1 SAMA; 2, 'BES 8613, Three Rivers Station, Site 312, Old production bore, Plutonic Borefield, 25.26745°S 119.16398°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32954–32955; 1 (partial), 'BES 8620, Three Rivers Station, bore MB5, Plutonic Borefield, 25.26730°S 119.16417°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32956; 5, 'BES 8625, Three Rivers Station, Limestone Well, 25.28313°S 119.175773°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', 2 WAM 32957–32958, 3 SAMA; 3, Ditto except, 'BES 8651', SAMA; 2 (1 partial), 'BES 8633; Three Rivers Station, bore MB3, Plutonic Borefield,

25.26943°S 119.17202°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32959–32960; 3, 'BES 8656/7, Three Rivers Station, bore MB2, Plutonic Borefield, 25.27360°S 119.17200°E, 26/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', 2 WAM 32961–32962, 1 SAMA.

Description (number examined, 19) Figs 55–60

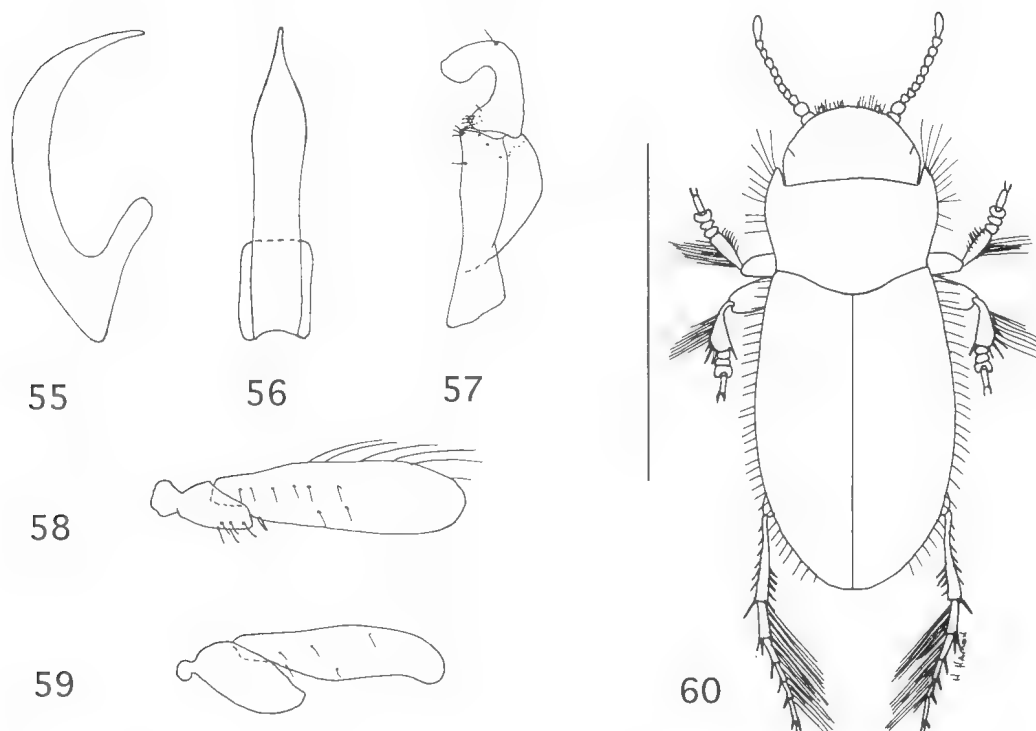
Habitus. Length 1.3–1.5 mm; broadly oval, relatively flat, weakly constricted at base of pronotum; uniformly light testaceous; hindwing vestigial, about one-quarter length of elytron.

Head. A little narrower than elytra; smooth, reticulation strong, punctures sparse, very small; subparallel in posterior half, widest just behind eye remnant; eye remnant reduced to single suture. Antenna relatively stout, segment 1 cylindrical, segment 2 oval, segment 3 much smaller and narrower, segments 4 to 10 equal in length becoming progressively wider, segment 11 about twice length of segment 10. Maxillary palpus stout, segment 4 a little shorter than segments 1 to 3 combined, oblique row of long setae on outer side, tip truncated.

Pronotum. Almost as wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles obtuse; smooth, with sparse, very weak punctures and a row of stronger punctures along front margin; strongly reticulate; basal plicae absent; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest in middle, smooth, sparsely covered with small punctures each with a short seta; row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with a few setiferous micropunctures towards apex and sides. Epipleuron undifferentiated; portion of elytron visible ventrally thin except for extreme shoulder.

Ventral surface. Prosternal process relatively broad, strongly narrowed between coxae, not reaching mesothorax, apical half almost parallel-sided, tip with small point, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply triangular in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines relatively well marked, quite widely spaced, reaching nearly to metasternum, weakly diverging towards front; a few small setae-bearing punctures



FIGURES 55–60. *Bidessodes gutteridgei*: 55, lateral view of central lobe of aedeagus; 56, ditto dorsal view; 57, paramere; 58, mesotrochanter and mesofemur; 59, metatrochanter and metafemur; 60 dorsal view. Scale bar represents 1 mm (habitus only).

towards midline; strongly reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, ventrites 3 and 4 with a long central seta or bunch of long setae; strongly reticulate.

Legs. Protibia broad, inner edge straight, outer edge bowed, widest near apex where it is about four times its basal width; protarsi quite strongly expanded, segment 1 broad, narrowing at base, segment 2 a little wider and a little shorter than segment 1, segment 3 as long as first and a bit wider, very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with quite dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of three to four spines on inner edge; mesofemur with row of six short spines along hind edge in basal half (Fig. 58); mesotibia broad, slightly angular; mesotarsi narrower than protarsi. Metatrochanter tip

rounded, well separated from femur (Fig. 59); metafemur stout, lacking spines; metatibia strongly curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

Male. No external differences between the sexes. Median lobe of aedeagus variable in width along shaft, tip bluntly pointed; paramere broad, apical segment hook-shaped (Figs 55–57).

Etymology

Named after Rob Gutteridge, who has very ably illustrated many of these beetles.

Remarks

A small species best recognised by the stout antenna, slightly angular mesotibia and large metatrochanter with its tip well separated from the metafemur. Its placement in *Bidessodes* is based primarily on evidence from DNA sequence data which suggest a relationship with *B. limestoneensis* and, more distantly, with *B. bilita*

Watts and *B. mjobergi* (Zimmermann.) (See also under *B. limestoneensis*.) There are no morphological characters that would negate its placement in *Bidessodes* as currently defined.

***Bidessodes limestoneensis* sp. nov.**

Types

Holotype: m: 'BES 8625, Three Rivers Station, Limestone Well, 25°16'59"S 119°10'33"E, 26/8/2001, W.F. Humphreys, T. Karanovic & J.M. Waldo', WAM 32951. In spirit.

Description (number examined, 1) Figs 61–66

Habitus. Length 4.2 mm; relatively flat, strongly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, about one-half length of elytron.

Head. About as wide as elytra; smooth, moderately reticulate with small meshes, punctures sparse, very small; subparallel in posterior half, widest in middle behind eye remnant; eye remnant reduced to two well-separated short sutures at side of head. Antenna very thin, segments subequal, apical segment a bit longer than penultimate (Fig. 66). Maxillary palpus thin, elongate, apical segment about same length as segments 1 to 3 combined.

Pronotum. As wide as elytra; anteriolateral angles projecting strongly forward; base quite strongly narrowed, posterolateral angles obtuse; smooth, moderately reticulate, meshes small; punctures sparse, weak; basal plicae weak, straight, reaching to about one-quarter way along pronotum; with row of long setae laterally, denser towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest behind middle, smooth, sparsely covered with small shallow punctures, row of long setae near lateral edge, a few additional larger punctures with long setae, more frequent towards sides. Epipleuron weakly differentiated, that portion of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to be virtually absent along rest of elytron.

Ventral surface. Prosternal process moderately broad, strongly narrowed between coxae, not reaching mesothorax, apical half almost parallel-sided, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly triangular in front in midline; wings short, very narrow; broadly rounded in

midline behind; reaching a little beyond midway to metacoxae. Metacoxal plates large, metacoxal lines weakly defined, relatively close, moderately widely spaced, reaching nearly to metasternum, evenly diverging; a few small setae-bearing punctures towards midline; finely reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct towards midline, becoming indistinct laterally, ventrites 3 to 5 mobile, sparsely covered with small seta-bearing punctures, weakly reticulate, ventrites 3 and 4 with a long central seta or bunch of long setae.

Legs. Protibia very narrow, slightly bowed, widest past middle where it is about three times its basal width; protarsi expanded, segment 1 round, segment 2 a little broader and a little shorter, segment 3 about twice as long and as broad as segment 1 and very deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with very dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with row of setae on inner edge; mesofemur with two comb-like rows of spines along hind edge (Fig. 64); mesotibia narrow, more strongly bowed than protibia; mesotarsi narrower than protarsi. Metatrochanter tip rounded (Fig. 65); metafemur elongate, lacking spines; metatibia thin, curved, widening towards apex; metatarsi elongate, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination about as long as others; claws weak.

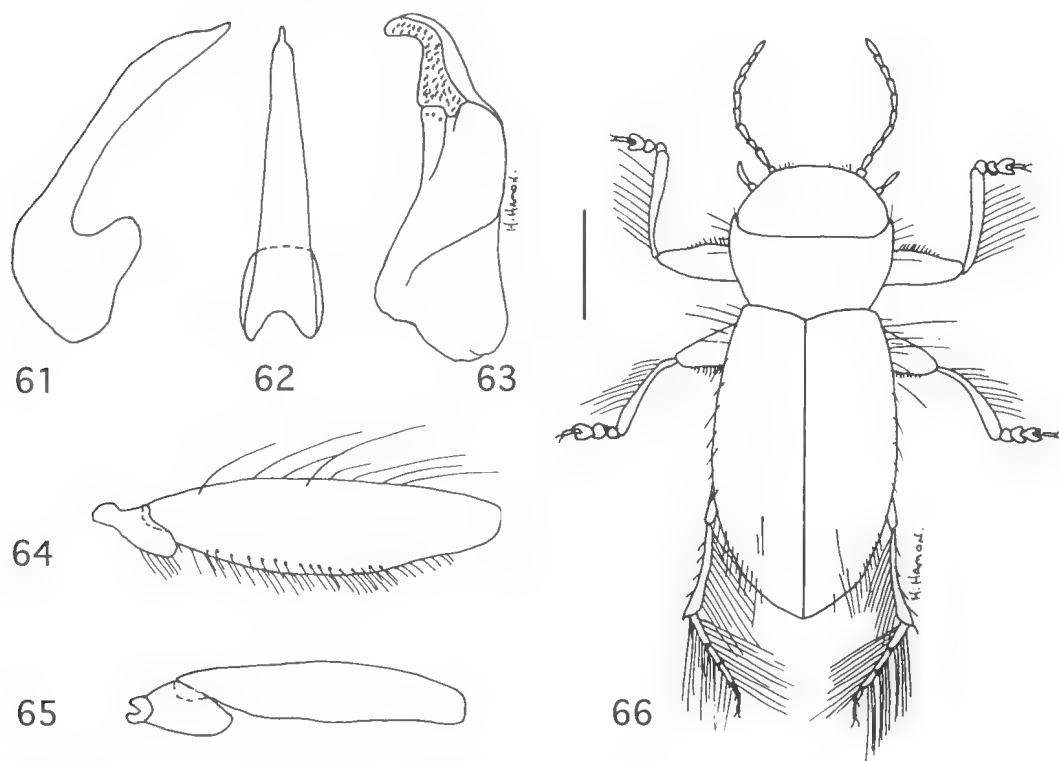
Male. Female not known. Median lobe of aedeagus progressively narrowing to near apex where it rapidly narrows to blunt tip; paramere narrow, apical portion without well separated apical lobe, apical segment with inner half with different surface texture to outer (Figs 61–63).

Etymology

Named after the type locality.

Remarks

A relatively large species with numerous characters setting it apart from other Australian stygobitic *Bidessini*. Most noticeably the long thin antenna, bowed mesotibia and unusually thin legs. The species will key to *Bidessodes* in Bistrom (1988) and the male genitalia resemble *B. flavosignatus* (Zimmermann). DNA sequence data (Cooper et al 2002) somewhat distantly groups it with the previous species, *B. gutteridgei* sp. nov., and with *B. bilita* and *B. mjobergi*. Its large size



FIGURES 61–66. *Bidessodes limestoneensis*: 61, lateral view of central lobe of aedeagus; 62, ditto dorsal view; 63, paramere; 64, mesotrochanter and mesofemur; 65, metatrochanter and metafemur; 66 dorsal view. Scale bar represents 1 mm (habitus only).

and thin prolegs readily separate it from *B. gutteridgei*. Additional studies incorporating more specimens of Australian *Bidessodes* (which DNA sequence data strongly suggest are not closely related to the South American *Bidessodes*) and additional specimens are needed to confirm the placement of *B. limestoneensis* with the Australian *Bidessodes*.

Nirripiri Watts & Humphreys

Nirripiri darlotensis sp. nov.

Types

Holotype: m: 'BES 6635, Melrose Station (Lake Darlot), mineral exploration bore near Halfpenny Well, 27°41'48"S 121°20'22"E, 13/5/2001, coll. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32963. Slide mounted.

Paratypes: 11, 7 (2 partial) as for holotype, 5 (2 partial) WAM 32964–32968, 2 SAMA; 2, as for holotype except 'BES 6636', WAM 32969–

32970; 2, as for holotype except 'BES 6639', SAMA.

Description (number examined, 12) Figs 67–72

Habitus. Length 3.5–4.1 mm; elongate, relatively flat, slightly pug-nosed, moderately constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing reduced to one-third length of elytron.

Head. Large, almost as wide as elytra; smooth, very weakly reticulate, scattered small punctures and dense band of setiferous punctures across rear; sides subparallel in posterior half; eye remnant reduced to a small suture in middle near edge. Antenna thin, segments 1 and 2 cylindrical, segments 3 to 10 subequal with segment 7 largest, segment 11 a bit longer than segment 10. Maxillary palpus thin, elongate, segment 4 a little longer than segment 3.

Pronotum. About as wide as elytra; anteriolateral angles thin, projecting strongly forward; moderately narrowed before base, sides slightly sinuate; posterolateral angles obtuse;

virtually impunctate except for band of strong punctures along front margin; long lateral setae restricted to apical third.

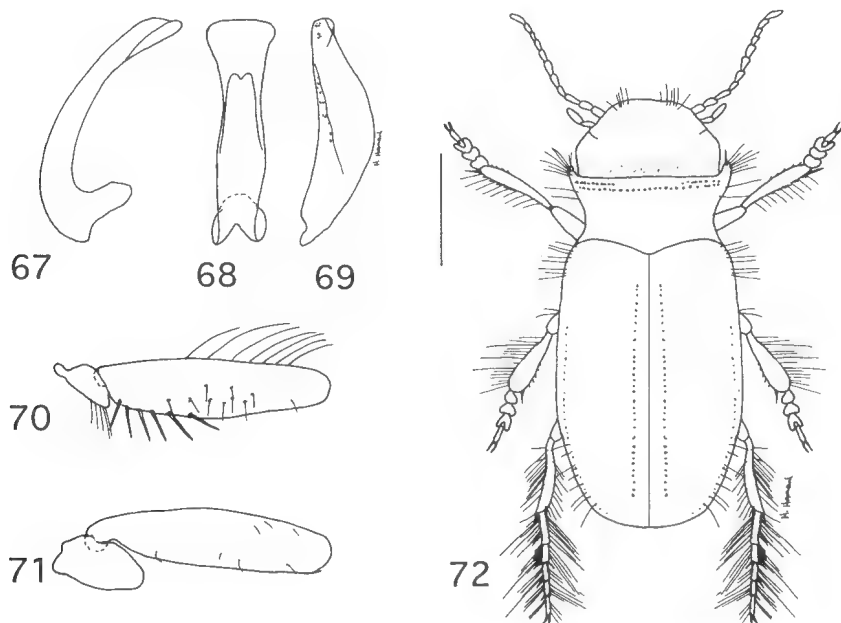
Elytra. Not fused but tightly closed, lacking inner ridges; elongate/oval, widest behind middle, smooth, a few scattered very small punctures, a row of punctures adjacent to suture; a few additional larger punctures with long setae, more frequent towards sides. Setiferous micropunctures over most of underside, denser at base, apex and along suture line. Epipleuron not differentiated from rest of elytron, that part of elytron visible ventrally relatively broad for almost the whole length of elytron.

Ventral surface. Prosternal process very narrow between coxae, not reaching mesothorax, apical half narrowly spatulate, point rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum triangularly pointed in front in midline; wings very narrow, short; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct towards sides, ventrites 3 to 5 mobile, virtually impunctate

except for a few long central seta or bunch of long setae.

Legs. Protibia narrow, widest a little past middle where it is about four times its very narrow basal width; protarsi moderately expanded, segment 1 transversely oval, segment 2 about size of segment 1, segment 3 about twice length of segment 2, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of seven to eight relatively long but weak spines along hind edge in basal half; mesotarsi less expanded than protarsi. Metatrochanter elongate/oval, tip rounded; metafemur thin, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi elongate, segment 1 longest, segments 2 to 4 subequal, in combination segments 1 and 2 about same length as others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Antennae of male slightly stouter than female. Median lobe of aedeagus broad, flat, widening at apex; paramere relatively narrow, apex rounded with small flap of tissue (Figs 67–69).



FIGURES 67–72. *Nirripipti darlotensis*: 67, lateral view of central lobe of aedeagus; 68, ditto dorsal view; 69, paramere; 70, mesotrochanter and mesofemur; 71, metatrochanter and metafemur; 72 dorsal view. Scale bar represents 1 mm (habitus only).

Etymology

Named after the type locality.

Remarks

A large species with the elytra tending to wrap around the abdomen, and with thin antennae with segment 3 a bit longer than segment 2. The only other species to have a broad band of small setiferous punctures across the back of the head is the much smaller *N. melroseensis* which was collected from the same bore hole.

Nirripiri fortisspina sp. nov.*Types*

Holotype: m: 'BES 6645, Pinnacles Station, Site 432, 28°15'27"S 120°07'37"E, 14/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32971. Slide mounted.

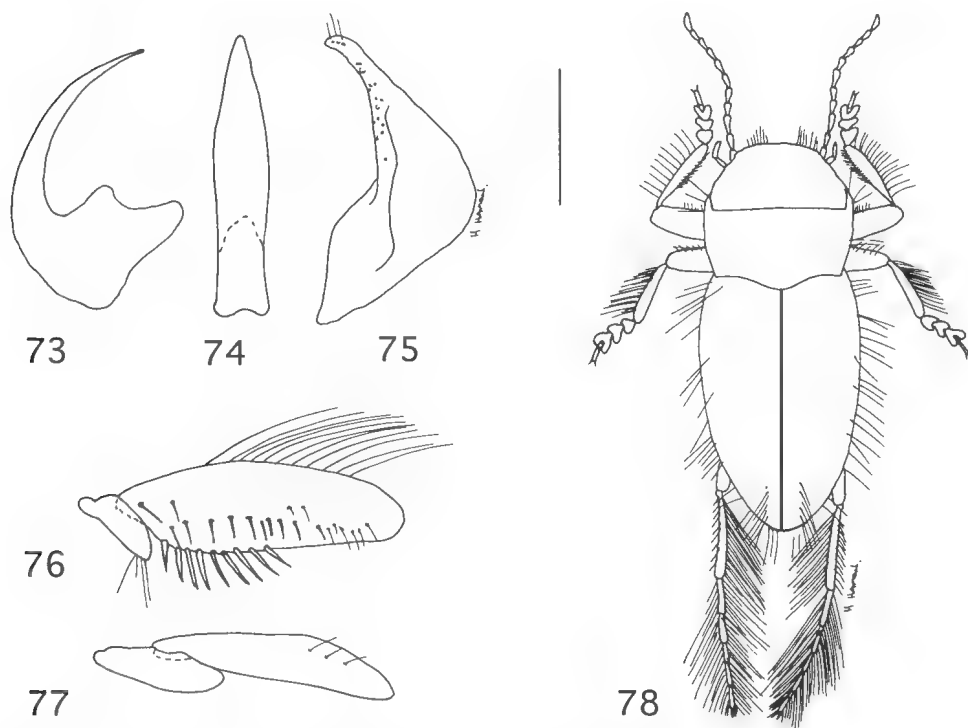
Paratypes. 15; 13, as for holotype, 7 WAM 32972–32978, 6 SAMA; 2, as for holotype except 'BES 6646', SAMA.

Description (number examined, 16) Figs 73–78

Habitus. Length 2.5–3.0 mm. elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to small flap.

Head. Large, nearly as wide as elytra; smooth, weakly reticulate with small even meshes, a few small scattered punctures; sides subparallel in posterior half; eye remnant reduced to a short suture near edge. Antenna thin, segments 1 and 2 almost cylindrical, segments 3 to 10 approximately same length, widening slightly towards their apices, segments 3 and 4 narrowest, segment 11 a bit longer and narrower than segment 10. Maxillary palpus elongate, thin, segment 4 a little longer than segment 3.

Pronotum. About as wide as elytra; anteriolateral angles projecting strongly forward; wider anteriorly, evenly narrowing towards rear, posterolateral angles obtuse; very weakly reticulate, virtually impunctate except towards front margin, numerous long setae at side towards front.



FIGURES 73–78. *Nirripiri fortisspina*: 73, lateral view of central lobe of aedeagus; 74, ditto dorsal view; 75, paramere; 76, mesotrochanter and mesofemur; 77, metatrochanter and metafemur; 78 dorsal view. Scale bar represents 1 mm (habitus only).

Elytra. Not fused but tightly locked, lacking inner ridges; elongate, widest a bit anterior of middle, smooth, covered with fine reticulation; moderate number of relatively large punctures laterally; underside with dense setiferous micropunctures at apex and along suture line. Epipleuron not differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior quarter, then gradually narrowing, absent near apex of elytron.

Ventral surface. Prosternum very narrow, not much wider than procoxae; anterior half of prosternal process almost perpendicular to body, strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum only weakly extended forward in midline; wings very short, narrow; main portion almost parallel-sided; rounded in midline behind. Metacoxal plates large, metacoxal lines absent; weakly reticulate, impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, weakly reticulate, virtually impunctate except for a few long central seta or bunch of long setae.

Legs. Profemur with small peg-like seta on hind edge adjacent to trochanter; protibia narrow, widest past middle where it is about twice its basal width; protarsi quite strongly expanded, segment 1 broadly elongate not symmetric, basal half expanded backwards, apical half more expanded forwards, segment 2 about one-half length of segment 1, outer lobe more expanded; segment 3 as long as segment 1, deeply bifid, lobes slightly asymmetric; segment 4 very small and hidden within lobes of segment 3; segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of eight to nine very strong spines closely spaced along hind edge in basal half; mesotarsi symmetric, less expanded than protarsi. Metatrochanter narrowly elongate, apical half well separated from femur; metafemur thin, elongate, lacking spines; metatibia thin, weakly curved, approximately the same width throughout; metatarsi thin, elongate, segment 1 and others subequal in length, in combination segments 1 and 2 much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Little external difference from female. Median lobe of aedeagus narrowing rapidly in

apical quarter; paramere broadest in middle, apical quarter thin, apex with a bunch of short stout setae (Figs. 73–75).

Etymology

Latin. 'Forte spina' – strong spines.

Remarks

A relatively large distinctive species easily recognised by the row of strong spines on the mesofemur and the peculiarly asymmetric protarsi, as well as the thin elongate metatrochanters and thin elongate antenna. The prosternum is short with little area in front of the mesocoxae, resulting in a very perpendicular anterior portion to the prosternal process.

Nirripiriti hamoni sp. nov.

Types

Holotype: m: 'BES 8662, Milgun Station, Earrie Well, 25°07'22"S 118°05'44"E, 28/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32979. Slide mounted.

Paratypes: 3; 2, as for holotype, SAMA; 1, as for holotype except 'BES 8661, 27/8/2001', WAM 32980.

Description (number examined, 4) Figs 79–84

Habitus. Length 1.7 mm.; relatively broad, flat, strongly constricted at base of pronotum; elytra slightly flared at shoulders; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Relatively small, less than width of elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant reduced to a dark suture in middle near edge. Apical half of antenna relatively thick, segment 1 cylindrical, segment 2 oval, segments 3 to 4 much thinner than rest, segments 6 to 7 subequal, broader than segment 5, apical segment a bit longer and narrower than penultimate. Maxillary palpus elongate, segment 4 a little longer than segment 3.

Pronotum. A little narrower than elytra; anteriolateral angles projecting strongly forward to sharp point, sides strongly curved outwards; base strongly narrowed, posterolateral angles acute; strongly reticulate, virtually impunctate except towards front margin and laterally. Numerous long setae at sides towards front.

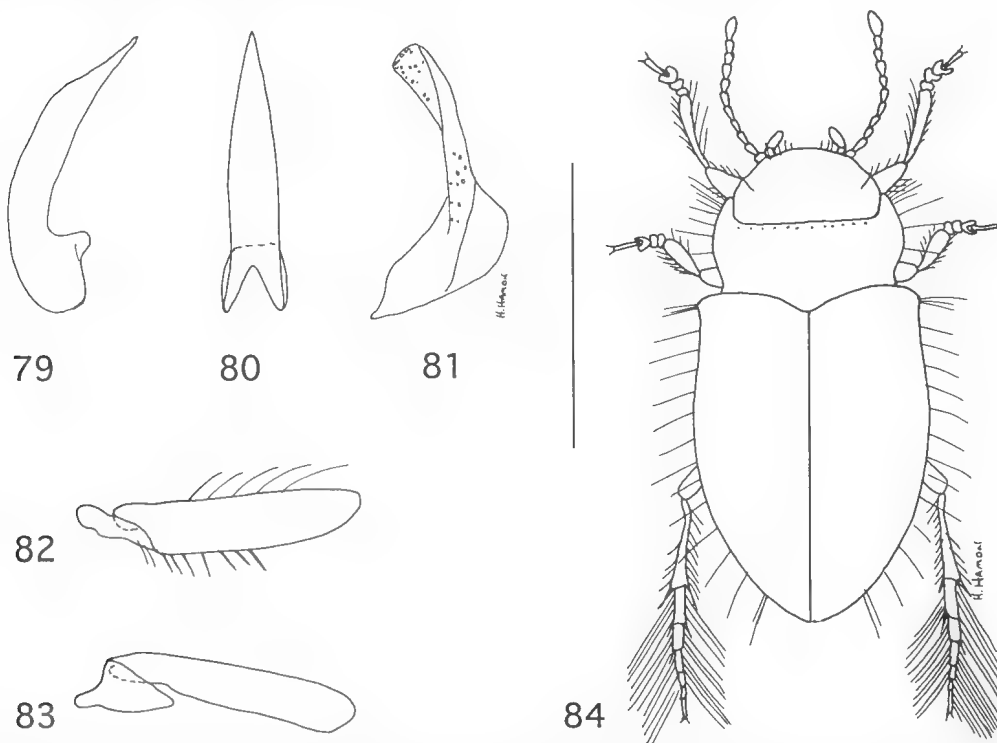
Elytra. Not fused but strongly locked, lacking inner ridges; elongate, widest in front of middle,

slightly constricted behind shoulders, smooth, covered with strong reticulation; moderately and evenly covered with small punctures; underside of elytron with a few additional larger punctures with long setae, more frequent towards sides; with numerous setiferous micropunctures densest towards apex and along suture line. Epipleuron not differentiated from rest of elytron, broad in anterior fifth, then rapidly narrowing to middle, virtually absent along rest of elytron.

Ventral surface. Prosternal process broad, strongly narrowed between coxae, not reaching mesothorax, apical half oval, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply pointed in front in midline; wings short, very narrow; narrowly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate, strongly reticulate with large meshes; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct except close to sides, ventrites 3 to 5 mobile, virtually impunctate except for a few long central setae or bunch of long setae.

Legs. Profemur noticeably grooved in apical half to accept protibia; protibia narrow, widest past middle where it is about three times its basal width; protarsi expanded, segment 1 broad, segment 2 about one-half length of segment 1, segment 3 relatively narrow, as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter relatively small, tip pointed; metafemur thin, lacking spines; metatibia relatively stout, very weakly curved, approximately the same width throughout; metatarsi relatively stout, segment 1 longest, segment 5 a little longer than segment 4, segments 1 and 2 in combination much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Male appendages not known. Median



FIGURES 79–84. *Nirripirti hamoni*: 79, lateral view of central lobe of aedeagus; 80, ditto dorsal view; 81, paramere; 82, mesotrochanter and mesofemur; 83, metatrochanter and metafemur; 84 dorsal view. Scale bar represents 1 mm (habitus only).

lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs. 79–81).

Etymology

Named after Harold Hamon, the illustrator of many of these beetles.

Remarks

A relatively small, strongly chitinated species easily recognised by its flared shoulders and strongly constricted pronotum and pointed metatrochanters.

Nirripiri killaraensis sp. nov.

Types

Holotype: m: 'BES 5561, Killara Station, Two Mile Bore, 26°21'11"S; 118°59'34"E, 5/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32981. Slide mounted.

Paratypes: 19; 1, as for holotype, SAMA; 1, 'BES 5597, Killara Station, uncased mineral exploration bore, Site 130, 26.34194°S; 118.96071°E, 6/5/2001, col. W.F. Humphreys, C.H.S. Watts & S. Cooper', SAMA; 8, 'BES 8125, Killara Station, Site 130, 26°20'31"S, 118°57'39"E, 21/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldoock', WAM 32928–32989; 9, ditto, except 'BES 8128', SAMA.

Description (number examined, 20) Figs 85–90

Habitus. Length 1.5–1.9 mm; boat-shaped, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Narrower than elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases arranged in lines; sides slightly curved; eye remnant reduced to a short suture in middle near edge. Antenna relatively thick, segment 1 narrow, cylindrical, segment 2 much larger, rounded, narrower at base, segments 3 and 4 narrow, segments 6 to 8 a bit wider than others, segment 11 is 1.5 times longer than penultimate. Maxillary palpus elongate, apical segment about as long as other segments combined.

Pronotum. Narrower than elytra; anteriolateral angles projecting strongly forward; sides weakly sinuate, posterolateral angles obtuse; quite strongly reticulate, a few small scattered punctures. Long setae at sides

Elytra. Not fused but tightly closed, lacking

inner ridges; elongate, widest behind middle, smooth, covered with fine reticulation; a few scattered small punctures, a few additional larger punctures with long setae, more frequent towards sides, underside with setiferous micropunctures at base, apex and along suture line. Epipleuron not differentiated; that portion of elytra visible ventrally, broad except near tip.

Ventral surface. Prosternal process strongly narrowed between coxae, tip pointed, nearly reaching mesothorax, apical half parallel with plane of body, anterior section perpendicular to plane of body, prosternum short and not much wider than procoxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate, reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner three-quarters and indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae, strongly reticulate, meshes small.

Legs. Protibia narrow, widest past middle where it is about twice its basal width; protarsi weakly expanded, segment 1 broadly triangular, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, a little longer than segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five spines along hind edge in basal half; mesotarsi much narrower than protarsi. Metatrochanter elongate/oval, apex bluntly pointed; metafemur elongate, lacking spines; metatibia almost straight, approximately the same width throughout; metatarsi elongate, segment 1 longest, segments 2 to 4 subequal, segments 1 and 2 in combination about same length as others, segments 2 to 5 without spines other than at apex; claws weak.

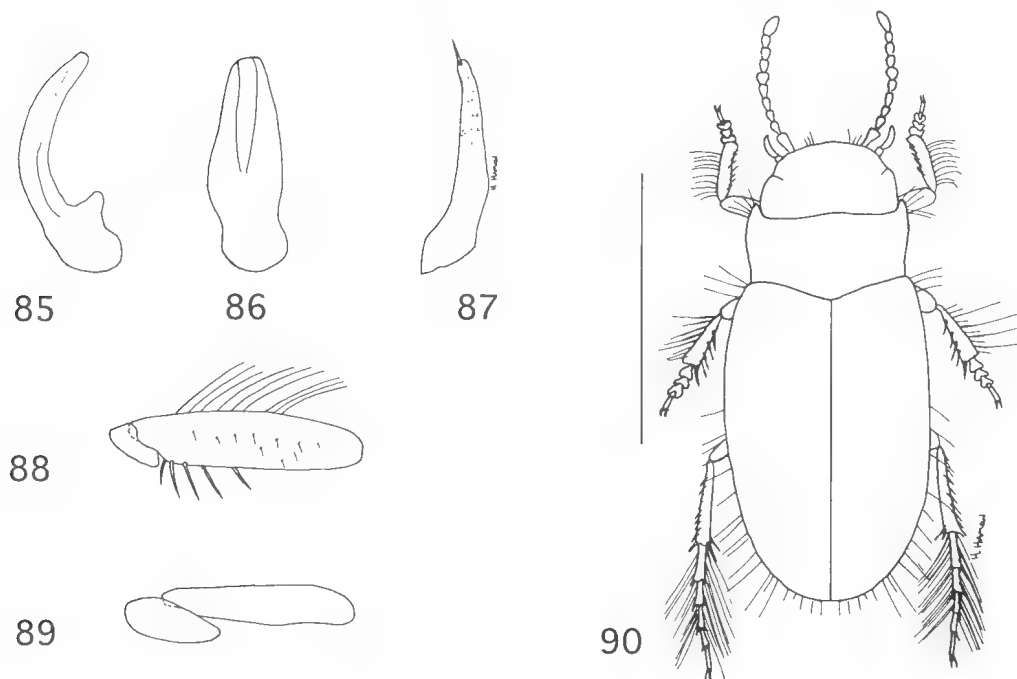
Male. Little difference from female. Median lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs. 85–87).

Etymology

Named after the pastoral station on which it was found.

Remarks

A moderately sized, boat-shaped species with



FIGURES 85–90. *Nirripirti killaraensis*: 85, lateral view of central lobe of aedeagus; 86, ditto dorsal view; 87, paramere; 88, mesotrochanter and mesofemur; 89, metatrochanter and metafemur; 90 dorsal view. Scale bar represents 1 mm (habitus only).

wrap-around elytra, and a pronotal process with a long point which nearly reaches the extension of the metasternum. A little smaller than the other boat-shaped Western Australian species, *N. skaphites*, and with the apex of the metatrochanters more rounded.

Nirripirti macrocephalus sp. nov.

Types

Holotype: male: 'BES 8089 NT: Napperby Station; bore RN 1561@ Herbert Well; 22°54'32"S 132°43'45"E; 18/6/2001. Col. W.F. Humphreys & R. Read.', NTM, I 001174. Slide mounted.

Paratype: 1, as for holotype, SAMA.

Description (number examined, 2) Figs 91–96

Habitus. Length 1.9–2.0 mm.; oval, relatively flat, strongly constricted at junction of pronotum/elytra; light testaceous, head a little darker; hindwing vestigial, reduced to tiny flap.

Head. Large, short, broad, deflexed downwards, as wide as elytra; smooth, weakly reticulate, virtually impunctate except a few small ones near

antennae bases; sides subparallel in posterior half; eye remnant reduced to a short suture in middle. Antenna thin, segments 1 and 2 cylindrical, segments 3 and 4 much thinner, 5 to 10 triangular, broader middle segments slightly larger, segment 11 twice length of segment 10. Maxillary palpus thin, elongate, segment 4 much longer than segment 5, some long setae towards apex of segments.

Pronotum. A little wider than elytra, much broader than long; anteriolateral angles projecting strongly forward, anterior edge sinuate; strongly constricted just before base, posterolateral angles acute; a few scattered very small punctures; numerous long setae at sides particularly towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; broad, widest at shoulders, smooth; weakly reticulate; a few scattered small punctures, some arranged in rows; a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with numerous, evenly spaced, setiferous micropunctures denser towards apex. Epipleuron not differentiated, that part of elytron visible ventrally broad in anterior fifth, rapidly

narrowing to be virtually absent along rest of elytron.

Ventral surface. Prosternum short, no longer than postcoxae, anterior portion of prosternal process rising perpendicularly with both a forward and a backward projection, anterior projection broad, rounded, posterior projection (process) broad, triangular; not reaching mesothorax. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings absent; broadly rounded in midline behind. Metacoxal plates large, reaching episternum, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

Legs. Protibia very narrow, widest near apex where it is about twice its basal width; protarsi moderately expanded, segment 1 broadly triangular, segment 2 a little shorter, segment 3 longer than segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with long adhesive

setae; claws short and simple. Mesotrochanter elongate/ oval, with a few fine setae at apex; mesofemur with row of four strong spines along hind edge in basal half; mesotibia curved, moderately flanged on inside near apex, mesotarsi simple, not expanded. Metatrochanter oval; metafemur elongate, lacking spines; metatibia stout, curved, moderately widening towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 a little shorter than others, all segments without spines other than at apex; claws weak.

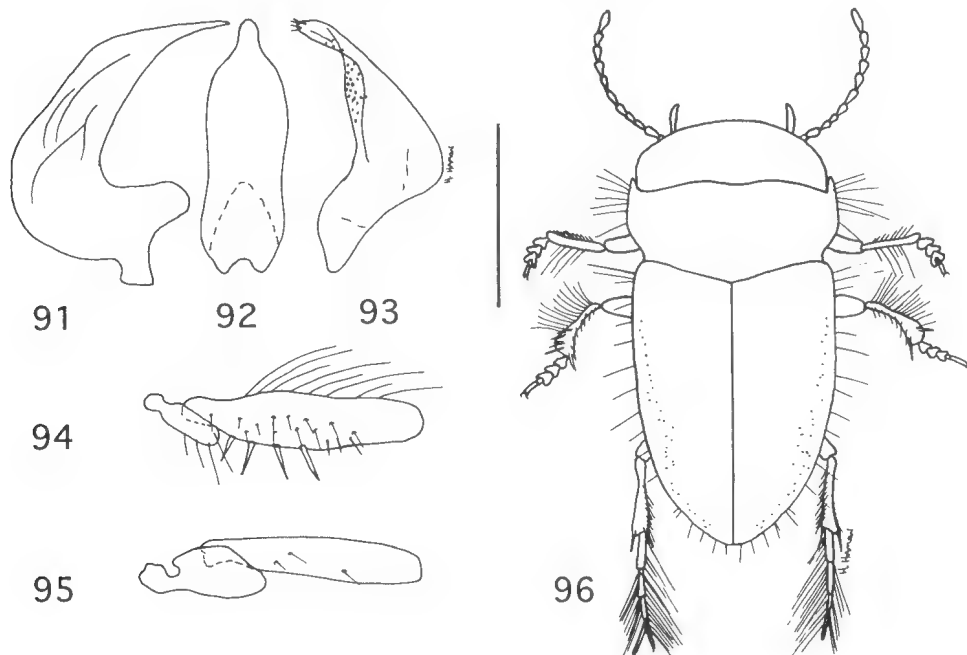
Male. Little difference from female. Median lobe of aedeagus broad, narrowing rapidly in apical quarter to sharp point, apical portion of paramere twisted, apex rounded (Figs 91–93).

Etymology

Latin. 'Macrocephalus'— big head; a reference to its unusually large deflexed head.

Remarks

A distinctive, moderate sized, well chitinated species, easily recognised by its very broad deflexed head as well as its thin legs and strongly constricted pronotum.



FIGURES 91–96. *Nirripiriti macrocephalus*: 91, lateral view of central lobe of aedeagus; 92, ditto dorsal view; 93, paramere; 94, mesotrochanter and mesofemur; 95, metatrochanter and metafemur; 96 dorsal view. Scale bar represents 1 mm (habitus only).

Nirripiirti melroseensis sp. nov.

Types

Holotype: m: 'BES 6635, Melrose Station (Lake Darlot), mineral exploration bore near Halfpenny Well, 27°41'48"S; 121°20'22"E, 13/5/2001, coll. W.F. Humphreys, C.H.S. Watts & S. Cooper', WAM 32990. Slide mounted.

Paratypes: 23; 10, as for holotype, SAMA; 2, as for holotype except 'BES 6639', WAM 32991–32992; 11, as for holotype except 'BES 6636', WAM 33927–33937.

Description (number examined, 24) Figs 97–102

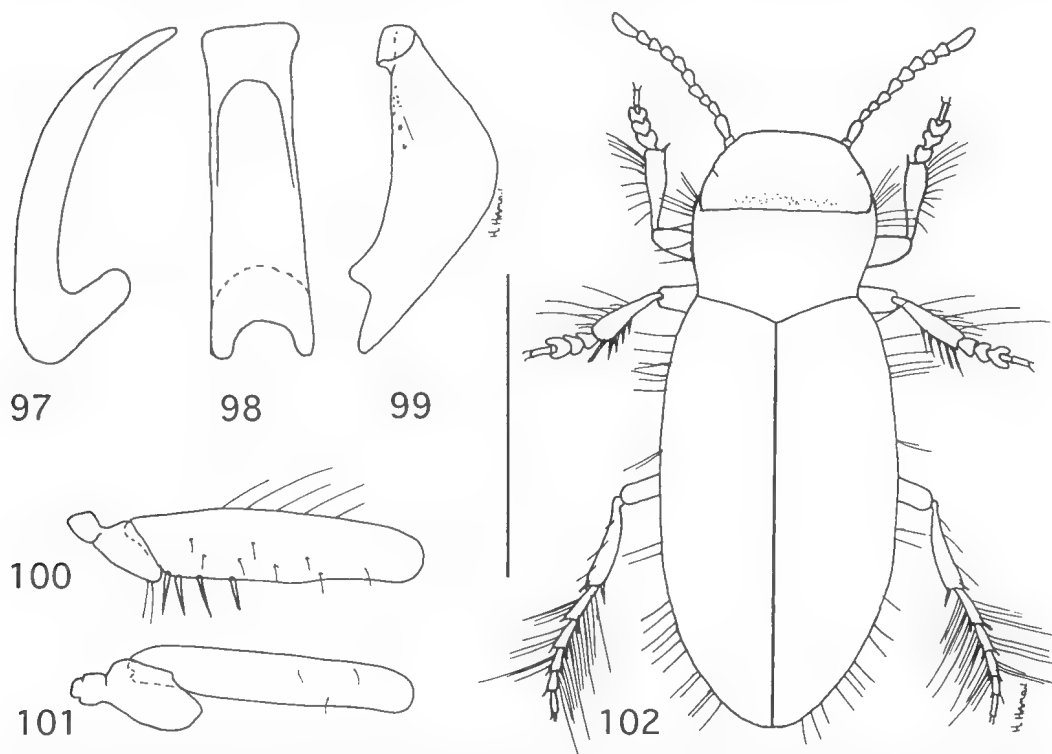
Habitus. Length 1.8–2.0 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing reduced to one-third length of elytron.

Head. Much narrower than elytra; smooth, strongly reticulate with small even meshes, moderately dense band of setiferous punctures across rear; sides subparallel in posterior half; eye remnant reduced to a suture in middle at side. Antenna relatively thick, segment 1 robust,

cylindrical, segment 2 a little wider and more oval, segments 3 to 10 narrow and shorter, subequal, segment 11 about as wide and a bit longer than segment 10. Maxillary palpus elongate, apical segment about twice as long as segment 10.

Pronotum. Much narrower than elytra, about same width as head; anteriolateral angles projecting strongly forward; sides narrowing slightly posteriorly, posterolateral angles obtuse; strongly reticulate, virtually impunctate except towards front margin and rear corners. Long setae at sides, more extensive towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, almost parallel-sided, smooth, covered with fine reticulation; a few scattered small punctures, several rows of widely spaced small punctures; a sparse row of large shallow punctures adjacent to suture; a few additional larger punctures with long setae, more frequent towards sides; underside of elytron with quite dense setiferous micropunctures at apex and narrowly along suture line. Epipleuron not differentiated, that part of elytron visible ventrally



FIGURES 97–102. *Nirripiirti melroseensis*: 97, lateral view of central lobe of aedeagus; 98, ditto dorsal view; 99, paramere; 100, mesotrochanter and mesofemur; 101, metatrochanter and metafemur; 102 dorsal view. Scale bar represents 1 mm (habitus only).

moderately broad in anterior quarter, then gradually narrowing to apex.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half relatively narrow, parallel-sided, tip pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings short, very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; strongly reticulate, virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 possibly fused, sutural lines distinct, ventrites 3 to 5 mobile, moderately reticulate, virtually impunctate except for a few long central setae or bunch of long setae.

Legs. Protibia elongate, relatively broad, widest near apex where it is about three times its basal width; protarsi weakly expanded, segment 1 cylindrical, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about one-half length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter elongate/oval, apex somewhat truncated; metafemur thin, lacking spines; metatibia moderately curved, widening somewhat towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 slightly shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Little external difference between the sexes. Median lobe of aedeagus broad, widening slightly at apex; paramere broad, narrowing towards apex, apex bent over (Figs 97–99).

Etymology

Named after the pastoral station on which it was found.

Remarks

A moderate sized, elongate species, with head and pronotum about the same width and much narrower than elytra, rather squat metatrochanters and thin metafemurs and metatibia which are strongly curved in Bidessine fashion. Across the rear of the head is a relatively wide band of small setiferous punctures which are otherwise only

present in the much larger *N. darlotensis*, which was found in the same bore hole.

Nirripiri milgunensis sp. nov.

Types

Holotype: m: 'BES 8661 Milgun Station, Earrie Well, 25°07'22"S; 118°05'44"E, 27/8/2001, col. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 32993. Slide mounted.

Paratypes: 4; 1, as for holotype, SAMA; 3 (1 partial), as for holotype except 'BES 8662, 28/8/2001', 2 (1 partial) WAM 32994–32995, 1 SAMA.

Description (number examined, 5) Figs 103–108

Habitus. Length 1.2–1.3 mm; elongate, almost parallel-sided, relatively flat, very weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Large, nearly as wide as elytra; smooth, moderate reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant absent. Antenna stout, segment 1 cylindrical, segment 2 large oval, segments 3 to 5 thinner than rest, segment 11 about 1.5 times as long as segment 10. Maxillary palpus stout, segment 4 much longer than segment 3.

Pronotum. About as wide as elytra; anteriolateral angles projecting strongly forward, sides straight, base not constricted, posterolateral angles obtuse; quite strongly reticulate, virtually impunctate except towards front margin; some long setae at side towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, parallel-sided, smooth, covered with strong reticulation; a few scattered small punctures; additional larger punctures with long setae, more frequent towards sides; setiferous micropunctures over most of underside denser near base, at apex and along suture line. Epipleuron not differentiated, that part of elytron visible ventrally broad in anterior fifth, then progressively narrowing to near apex.

Ventral surface. Prosternal process relatively narrow, strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, tip pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum broadly pointed in front in midline; wings short, narrow; bluntly triangular in midline behind.

Metacoxal plates large, metacoxal lines absent; virtually impunctate; moderately reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

Legs. Profemur relatively stout; protibia narrow, widest at apex where it is about three times its basal width; protarsi quite strongly expanded, segment 1 broadly triangular, segment 2 not much shorter than segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, broadening towards apex, a little curved, about length of segment 3; segments 1 to 3 a little asymmetric with the outer lobe larger than inner, with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate/oval with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi much less expanded than protarsi. Metatrochanter large, oval, tip separated from

metafemur; metafemur stout, lacking spines; swimming-hairs sparse; metatibia weakly curved, widening slightly towards apex; metatarsi stout, elongate, impunctate, segment 1 longest, segment 5 twice the length of segment 4, segments 2 and 3 subequal, segments 1 and 2 in combination about as long as others, segments 2 to 5 without spines other than at apex; claws weak.

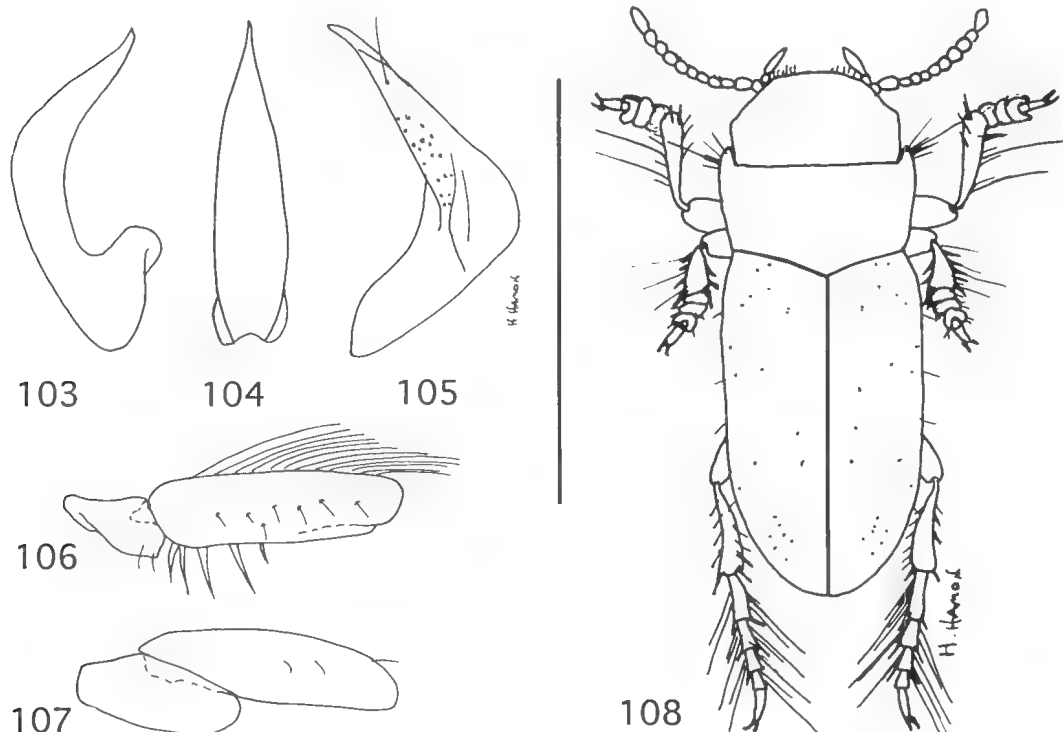
Male. Little difference from female. Median lobe of aedeagus narrowing rapidly in apical quarter; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs. 103–105).

Etymology

Named after the pastoral station on which it was found.

Remarks

A very small species, virtually lacking any trace of an eye remnant, pronotum not constricted, strong spines on the mesofemur, large metatrochanters, and metatarsal segment 4 only about one-half the length of segment 3.



FIGURES 103–108. *Nirripipti milgunensis*: **103**, lateral view of central lobe of aedeagus; **104**, ditto dorsal view; **105**, paramere; **106**, mesotrochanter and mesofemur; **107**, metatrochanter and metafemur; **108** dorsal view. Scale bar represents 1 mm (habitus only).

Nirripirti napperbyensis sp. nov.*Types*

Holotype: m: 'BES 8091. NT: Napperby Station., Bore RN 1561 at Herbert Well, 22°54'32"S 132°43'45"E, 17/6/2001, Col. W.F. Humphreys & R. Read', NTM I 001175. Slide mounted.

Paratypes: 7; 5, as for holotype, 2 WAM 32996–32997, 3 SAMA; 2, as for holotype except 'BES 8090', WAM 32998–32999.

Description (number examined, 8) Figs 109–114

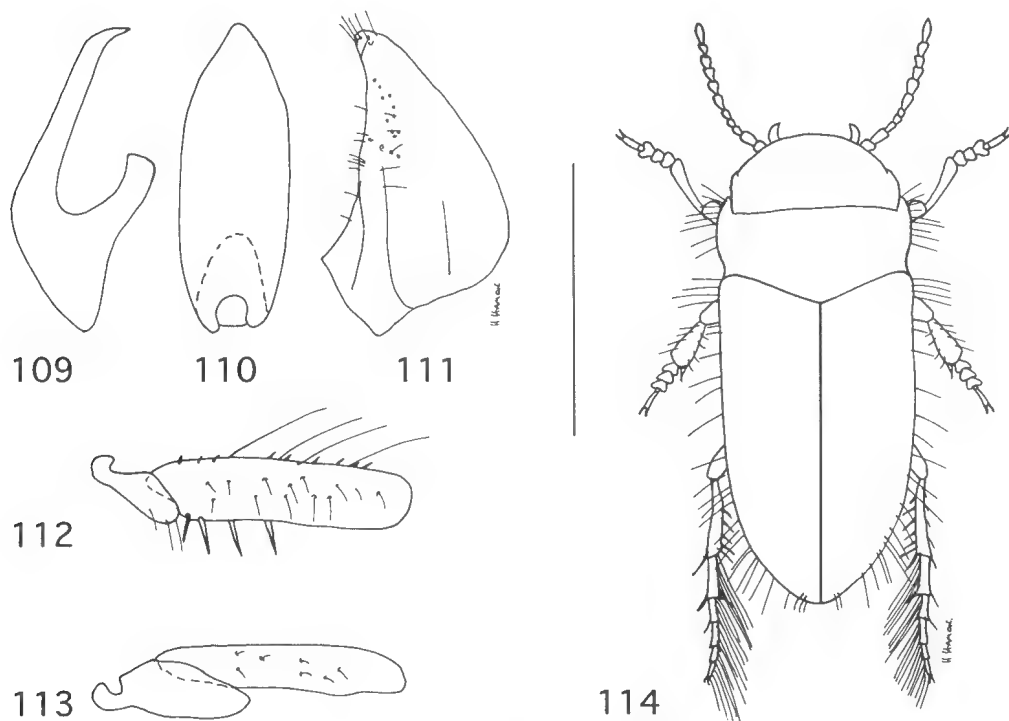
Habitus. Length 1.7–1.8 mm; elongate, relatively flat, weakly constricted at junction of pronotum/elytra; light testaceous, head a little darker; hindwing vestigial, reduced to tiny flap.

Head. Large, broad, a little narrower than elytra; smooth, very weakly reticulate, a few very small scattered punctures; sides slightly converging towards rear; eye remnant reduced to a very short suture. Antenna relatively thick,

segment 1 cylindrical, segment 2 enlarged towards apex, segments 3 and 4 much shorter and thinner, segments 5 to 10 similar in shape, middle ones slightly larger, segment 11 about twice as long as segment 10. Maxillary palpus stout, elongate, segment 4 twice as long as segment 3, some long setae towards apex of segments.

Pronotum. Almost same width as elytra; anteriolateral angles projecting strongly forward; sides weakly curved, weakly constricted before base; posterolateral angles acute; weakly reticulate, sparse small punctures, larger punctures laterally, denser towards front; long setae at sides in anterior half.

Elytra. Not fused, lacking inner ridges; elongate, widest behind middle, smooth, very weakly reticulate, a few scattered small punctures, several loose rows of widely spaced small punctures, a few additional larger punctures with long setae; underside of elytron with numerous evenly spaced setiferous micropunctures more frequent towards sides and denser towards apex.



FIGURES 109–114. *Nirripirti napperbyensis*: 109, lateral view of central lobe of aedeagus; 110, ditto dorsal view; 111, paramere; 112, mesotrochanter and mesofemur; 113, metatrochanter and metafemur; 114 dorsal view. Scale bar represents 1 mm (habitus only).

Epipleuron not differentiated, that part of elytron visible ventrally present only at extreme base.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half broad, diamond shaped, tip sharply pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternal plate bluntly pointed in front in midline; wings short, narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines weak, well separated, diverging in anterior half, not reaching metasternum; virtually impunctate, weakly reticulate; closely adpressed to first abdominal ventrite. Ventrites fused, sutural lines distinct in inner half absent laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

Legs. Protibia narrow, widest near apex where it is about twice its basal width; protarsi moderately expanded, segment 1 broadly triangular, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 1.5 times length of segment 3, segments 1 to 3 with adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four strong setae/spines along hind edge in basal half; mesotarsi narrower and longer than protarsi. Metatrochanter relatively large, oval, apex well separated from metafemur; metafemur relatively stout, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi with segment 1 longest, segment 4 shortest, in combination segments 1 and 2 much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Little external difference between the sexes. Median lobe of aedeagus short, flat, narrowing rapidly to sharp tip; paramere broad, apical half relatively broad, apex rounded (Figs 109–111).

Etymology

Named after the type locality.

Remarks

A moderately sized Northern Territory species with the ventrally visible parts of the elytra very short, and a broad pronotal process with a relative long sharp tip.

Nirripiri newhavenensis sp. nov.

Types

Holotype: m: 'BES 6681: NT: Newhaven Station, bore RN 12787; 22°43'41"S; 131°09'59"E; 15/6/2001. Col. W.F. Humphreys & A. Russ', NTM I 001176. Slide mounted.

Paratypes: 9; 4, as for holotype, 2 WAM 33000–33001, 2 SAMA; 2, ditto except 'BES 6665' WAM 33002–33003; 3, as for holotype except 'BES 6680', 1 WAM 33004, 2 SAMA.

Description (number examined, 10) Figs 115–120

Habitus. Length 1.5–1.7 mm; elongate, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly very light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Large, broader than long, nearly as wide as elytra; smooth, a few scattered small punctures, moderately reticulate; sides subparallel in posterior half; eye remnant reduced to a short broad suture in middle near side. Antenna stout, segment 1 wide cylindrical, segment 2 large oval, segments 3 and 4 much shorter and narrower, segments 5 and 6 approximately the same shape but narrower at base, segments 7 to 8 same shape becoming progressively slightly narrower, segment 11 nearly twice as long and about same width as segment 10. Maxillary palpus elongate, segment 4 longer than segment 3, some long setae towards apex of segments.

Pronotum. About as wide as elytra; anteriolateral angles projecting strongly forward; base moderately narrowed, posterolateral angles obtuse; moderately reticulate, virtually impunctate except for some relatively strong punctures towards sides and front margin. Long setae at sides particularly towards the front.

Elytra. Not fused, lacking inner ridges; elongate, sides narrowing slightly towards apex, smooth, moderately reticulate, disc covered with moderately sized punctures, absent at sides; a few additional larger punctures with long setae, more frequent towards sides; setiferous micropunctures over much of underside of elytron except towards sides. Epipleuron not differentiated, that portion of elytron visible ventrally relatively broad for all but apical portion of elytron.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in

midline; wings very short; broadly rounded in midline behind. Metacoxal plates large, reaching episternum, metacoxal lines absent; moderately reticulate, virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for a few long central setae or bunch of long setae.

Legs. Protibia narrow, widest at apex where it is about twice its basal width; protarsi quite strongly expanded, segment 1 broadly oval, segment 2 about one-half length of segment 1, segment 3 as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about 1.5 times length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter narrowly oval with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi not expanded, much narrower and longer than protarsi. Metatrochanter large, bluntly pointed, apex well

separated from metafemur; metafemur relatively broad, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi relatively stout, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

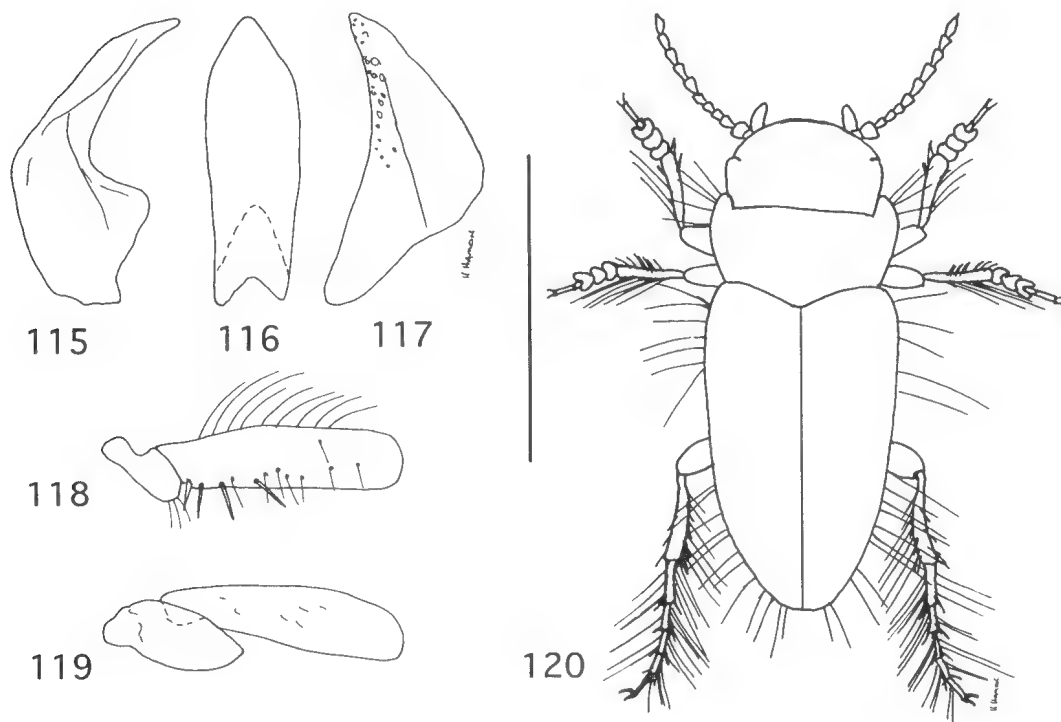
Male. Little difference from female. Median lobe of aedeagus narrowing rapidly in apical quarter; paramere relatively broad, apex blunt (Figs 115–117).

Etymology

Named after the type locality.

Remarks

A relatively small, lightly chitinised species with a large second antennal segment and the sides of the elytra wrapping over the abdomen for most of their length. Separated from the relatively similar *N. wedgeensis* by its larger size and quite strongly constricted base of the pronotum.



FIGURES 115–120. *Nirripiri newhavenensis*: 115, lateral view of central lobe of aedeagus; 116, ditto dorsal view; 117, paramere; 118, mesotrochanter and mesofemur; 119, metatrochanter and metafemur; 120, dorsal view. Scale bar represents 1 mm (habitus only).

Nirripiriti pentameres sp. nov.*Types*

Holotype: m: 'BES 6687: NT: Newhaven Station, Camel Well RN 15494, 22°22'56"S 131°11'23"E, 15/6/2001, col. W.F. Humphreys & A. Russ', NTM I 001177. Slide mounted.

Description (number examined, 1) Figs 121–126

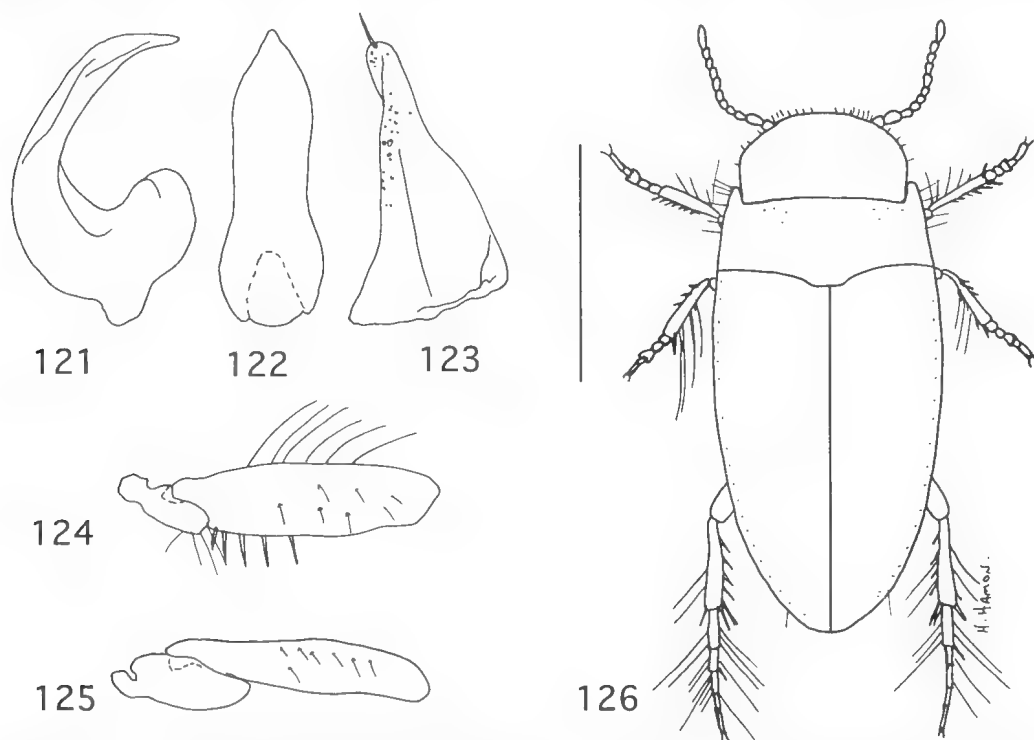
Habitus. Length 2.2 mm; elongate, relatively flat, slightly depressed in sutural region, not constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Large, narrower than elytra; smooth, very weakly reticulate, scattered small punctures; sides slightly converging in posterior half; eye remnant reduced to a short suture in middle near edge. Antenna relatively thin, segment 1 stout cylindrical, segment 2 slightly oval, segments 3 and 4 much thinner and shorter, segments 5 to 10 triangular, middle segments slightly larger, segment 11 nearly twice length of segment 10. Maxillary palpus elongate, segment 4 longer than segment 3.

Pronotum. About as wide as elytra; anteriolateral angles projecting strongly forward; sides weakly diverging posteriorly, not narrowed at base, posterolateral angles acute; scattered small punctures denser at sides; some long setae at sides in anterior half.

Elytra. Not fused, lacking inner ridges; elongate, widest in middle, smooth, a few scattered small punctures; a few additional larger punctures with long setae, more frequent towards sides; underside with scattered setiferous micropunctures over most of surface, denser towards apex and along suture line. Epipleuron weakly differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior quarter, then gradually narrowing to middle, virtually absent along rest of elytron.

Ventral surface. Prosternal process damaged in specimen, Mesocoxae in contact at midline. Metasternum sharply pointed in front in midline; wings very narrow; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; with sparse uniform covering of small punctures; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines



FIGURES 121–126. *Nirripiriti pentameres*: **121**, lateral view of central lobe of aedeagus; **122**, ditto dorsal view; **123**, paramere; **124**, mesotrochanter and mesofemur; **125**, metatrochanter and metafemur; **126**, dorsal view. Scale bar represents 1 mm (habitus only).

distinct, ventrites 3 to 5 mobile, moderate number of small punctures and a few long setae or small bunch of long setae in the middle of each segment.

Legs. Protibia narrow, widest near apex where it is about twice its basal width; protarsi not expanded, segments 1 to 3 relatively small, subequal, segment 3 weakly bilobed, segment 4 about one-third length of segment 3, not hidden in lobes of segment 3, segment 5 robust, cylindrical, about twice the length of segment 3, segments 1 to 3 without adhesive setae; claws relatively strong. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of five to six strong spines along hind edge in basal half; mesotarsi similar to protarsi. Metatrochanter elongate/oval; metafemur elongate, lacking spines; metatibia weakly curved, approximately the same width throughout; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 a little shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Female unknown. Median lobe of aedeagus short, broad, flat with sharp tip; paramere with relatively broad apical half, apex rounded (Figs 121–123).

Etymology

Latin. 'Penta meres' – five segments; based on its obviously five-segmented protarsus.

Remarks

A moderate sized, distinctive species, with narrow protibia, small head and no constriction at the junction of pronotum and elytra. The pro- and mesotarsi are elongate, cylindrical, with the third segment only weakly bifid, exposing the relatively large fourth segment. This trend is also apparent in other Northern Territory *Nirripiri* but is more pronounced in this species.

Nirripiri plutonicensis sp. nov.

Types

Holotype: m: 'BES 8606; Three Rivers Station, bore MB4 Plutonic Borefield; 25°16'43"S 119°11'00"E; 26/8/2001. coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', WAM 33005. Slide mounted.

Paratypes 97; 11, as for holotype, 4 WAM 33006–33009, 5 SAMA; 8, 'BES 8651, Three Rivers Station, Limestone Well, 25°16'43"S 119°11'00"E, 26/8/2001, coll. W.F. Humphreys,

T. Karanovic & J.M. Waldock', 7 WAM 33010–33016, 1 SAMA; 7 ditto except 'BES 8625', 3 WAM 33017–33019, 4 SAMA; 9, 'BES 8620, Three Rivers Station, MB5, Plutonic Borefield, 25°16'43"S 119°11'00"E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', 5 WAM 33020–33024, 4 SAMA; 41, 'BES 8611/2, Three Rivers Station, Site 312, disused production bore, Plutonic Borefield, 25.26745°S 119.16398°E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', 10 WAM 33793–33802, 31 SAMA; 2, 'BES 8639, Three Rivers Station, bore MB1, Plutonic Borefield, 25.29213°S 119.18107°E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', SAMA; 16, 'BES 8656/7, Three Rivers Station, bore MB2, Plutonic Borefield, 25.27360°S 119.17200°E, 26/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', 10 WAM 33803–33812, 6 SAMA; 3 (1 partial), 'BES 8642, Three Rivers Station, new unused bore next to Gascoyne River; 25.11780°S 119.15115°E, 27/8/2001, coll. W.F. Humphreys, T. Karanovic & J.M. Waldock', SAMA.

Description (number examined, 98) Figs 127–132

Habitus. Length 3.0–3.5 mm; elongate oval, relatively flat, moderately constricted at junction of pronotum/elytra; uniformly testaceous; hindwing vestigial, reduced to tiny flap.

Head. Large about same width as pronotum; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases; subparallel in posterior half; eye remnant reduced to short faint suture, not always visible. Antenna relatively thin, segments 3 to 4 thinner than rest, segment 11 a bit longer and narrower than segment 10. Maxillary palpus elongate, segment 4 a little longer than segment 3.

Pronotum. A little narrower than elytra; anteriolateral angles projecting strongly forward; base weakly narrowed, posterolateral angles obtuse; quite strongly reticulate, moderate number of scattered punctures and row along front margin. Sides with numerous long setae particularly towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, nearly parallel-sided, smooth, covered with moderately strong reticulation; sparsely covered with small punctures, several indistinct rows of widely spaced small punctures; a few additional larger punctures with long setae, more frequent towards sides, underside covered with setiferous micropunctures, denser towards apex and along suture line. Epipleuron not

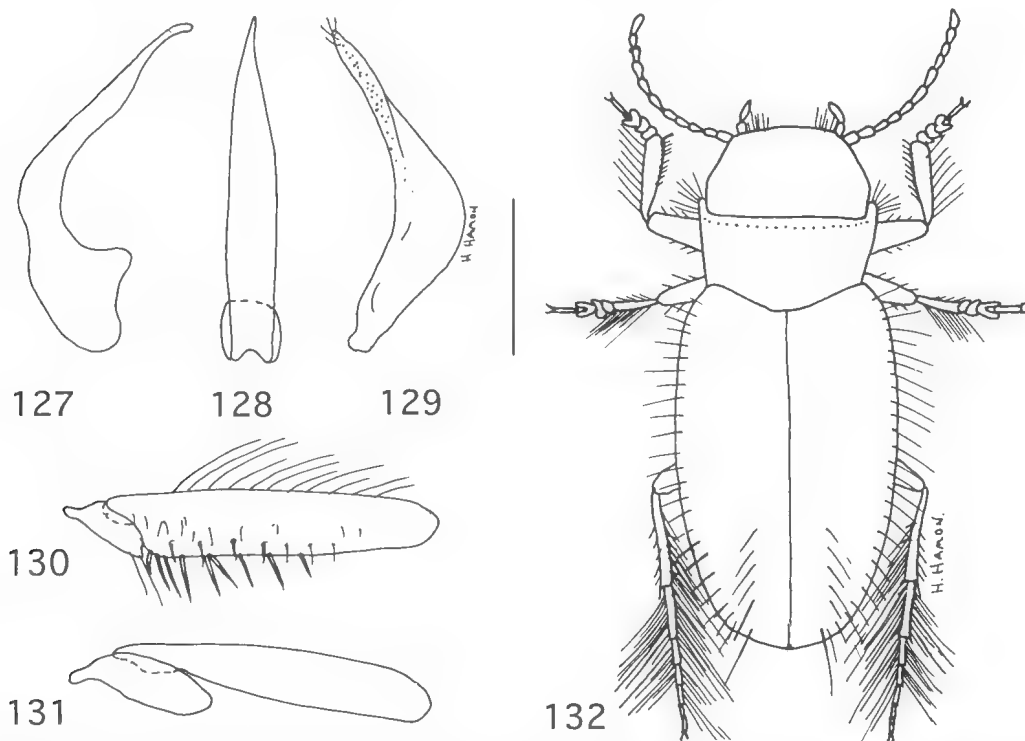
differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior fifth, then rapidly narrowing to middle.

Ventral surface. Prosternal process quite narrow, strongly narrowed between coxae, not reaching mesothorax, apical half spatulate, tip rounded; strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum bluntly pointed in front in midline; wings absent; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; strongly reticulate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half indistinct laterally, ventrites 3 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae.

Legs. Profemur with weak peg-like seta on hind edge adjacent to trochanter; protibia narrow, almost parallel-sided in apical half; protarsi expanded, segment 1 broad, segment 2 about one-half length of segment 1, segment 3 as long as

segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of six to eight strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter elongate/oval; metafemur thin, elongate, lacking spines; metatibia very weakly curved, approximately the same width throughout; metatarsi elongate, segment 1 much longer than others, segment 5 about 1.5 times length of segment 4, segments 2 and 3 subequal in length, segments 1 and 2 in combination a little longer than others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Little external difference between sexes. Median lobe of aedeagus sinuate in lateral view, narrowing to sharp point in apical half; paramere broad at base, apical half thin, tip with a bunch of long setae (Figs 127–129).



FIGURES 127–132. *Nirripirti plutonicensis*: 127, lateral view of central lobe of aedeagus; 128, ditto dorsal view; 129, paramere; 130, mesotrochanter and mesofemur; 131, metatrochanter and metafemur; 132, dorsal view. Scale bar represents 1 mm (habitus only).

Etymology

Named after the borefield in which it was found.

Remarks

A large strongly chitinised species with elytra not wrapping around abdomen, without metasternal wings, long thin hind legs and narrowly oval metatrochanters.

Nirripiriti skaphites sp. nov*Types*

Holotype: m: 'Karatundi, unlined well, 26°08'S; 118°41'E, 28/5/2001, coll.# 339-2 C.H.S. & G.A. Watts', WAM 33813. Slide mounted.

Paratypes: 3, as for holotype, 2 SAMA, 1 WAM 33814.

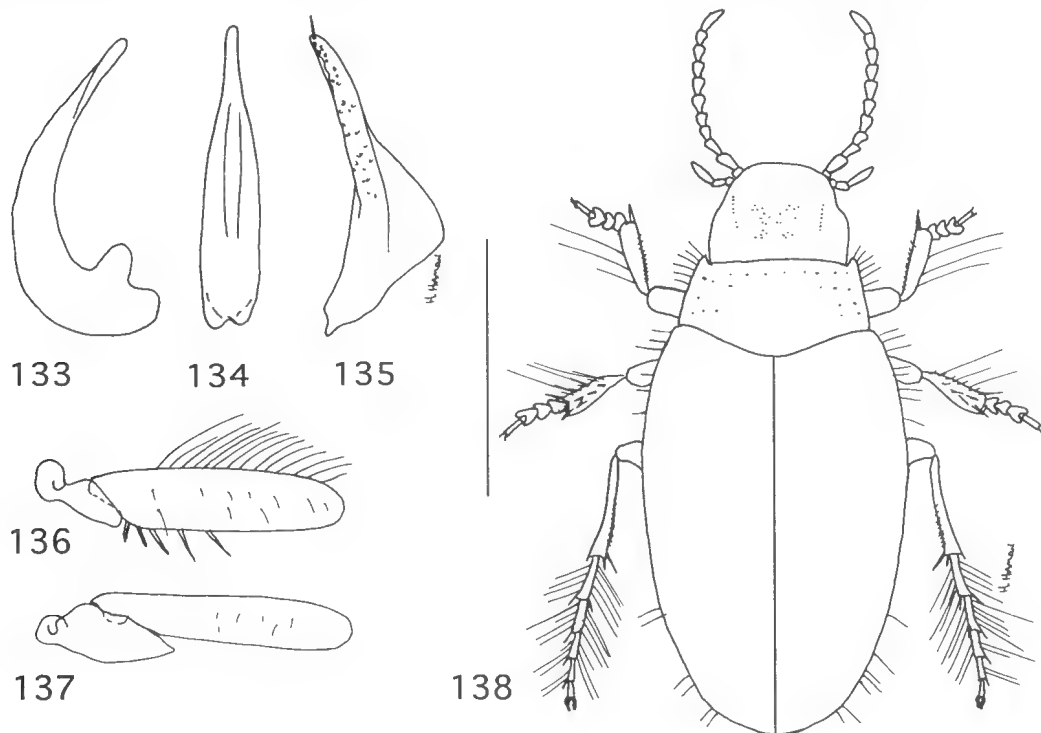
Description (number examined, 4) Figs 133–138

Habitus. Length 2.1–2.3 mm; elongate, boat-shaped, relatively flat, not constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. Small, about half width of elytra; smooth, moderately strong reticulation with small even meshes, virtually impunctate except a few near antennae bases and on disc; sides slightly curved in posterior half; eye remnant reduced to a short suture in middle near anterior edge. Antenna moderately thick, segment 1 cylindrical, segment 2 widening towards apex, segments 3 to 10 approximately equal in length, widening progressively to segment 5, segment 11 about twice length of segment 10. Maxillary palpus elongate, segment 4 about twice length of segment 3.

Pronotum. Narrower than elytra; anteriolateral angles projecting strongly forward; sides slightly diverging towards rear; posterolateral angles obtuse; strongly reticulate, a few small scattered punctures; numerous long setae at sides towards front.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest in middle, smooth, covered with fine reticulation; a few scattered small punctures, underside with a few setiferous micropunctures at apex, a few additional larger punctures with long setae, more frequent towards



FIGURES 133–138. *Nirripiriti skaphites*: 133, lateral view of central lobe of aedeagus; 134, ditto dorsal view; 135, paramere; 136, mesotrochanter and mesofemur; 137, metatrochanter and metafemur; 138, dorsal view. Scale bar represents 1 mm (habitus only).

sides. Epipleuron not differentiated, that part of elytron visible ventrally very broad until close to apex of elytron.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half broadly spatulate, weakly pointed, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum pointed in front in midline; wings short; broadly rounded in midline behind. Metacoxal plates large, metacoxal lines absent; a few small scattered very small punctures; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner two-thirds but absent laterally, ventrites 3 to 5 possibly immobile, virtually impunctate except for a few long central seta or bunch of long setae.

Legs. Protibia narrow, widest near apex where it is about twice its basal width; protarsi weakly expanded, segment 1 rectangular, segment 2 about one-half length of segment 1, segment 3 about as long as segment 1, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about twice length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate, rather angular, with a few fine setae at apex; mesofemur with row of five to six strong spines along hind edge in basal half; mesotarsi slightly less expanded than protarsi. Metatrochanter relatively broad, sharply pointed; metafemur elongate, lacking spines; metatibia weakly curved, widening a little towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 same length as others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Antenna a little stouter. Median lobe of the aedeagus narrow, narrowing in apical quarter; paramere broad at base, apical half thin, tip with a long setae (Figs 133–135).

Etymology

Latin. 'Skaphites' – boat-like.

Remarks

A moderate sized species with small head and no pronotal constriction, which give it a pronounced boat-like shape. The sharply pointed metatrochanters are also distinctive and separate it from the rather similarly shaped but smaller *N. killaraensis*.

Nirripiriti stegastos sp. nov.

Types

Holotype: m: 'Karatundi, un-lined well; 6°08'S; 118°41'E, 28/5/2001, coll. C.H.S. & G.A. Watts', WAM 33815.

Paratypes: 2, as for holotype, 1 WAM 33816, 1 SAMA.

Description (number examined, 3) Figs 139–144

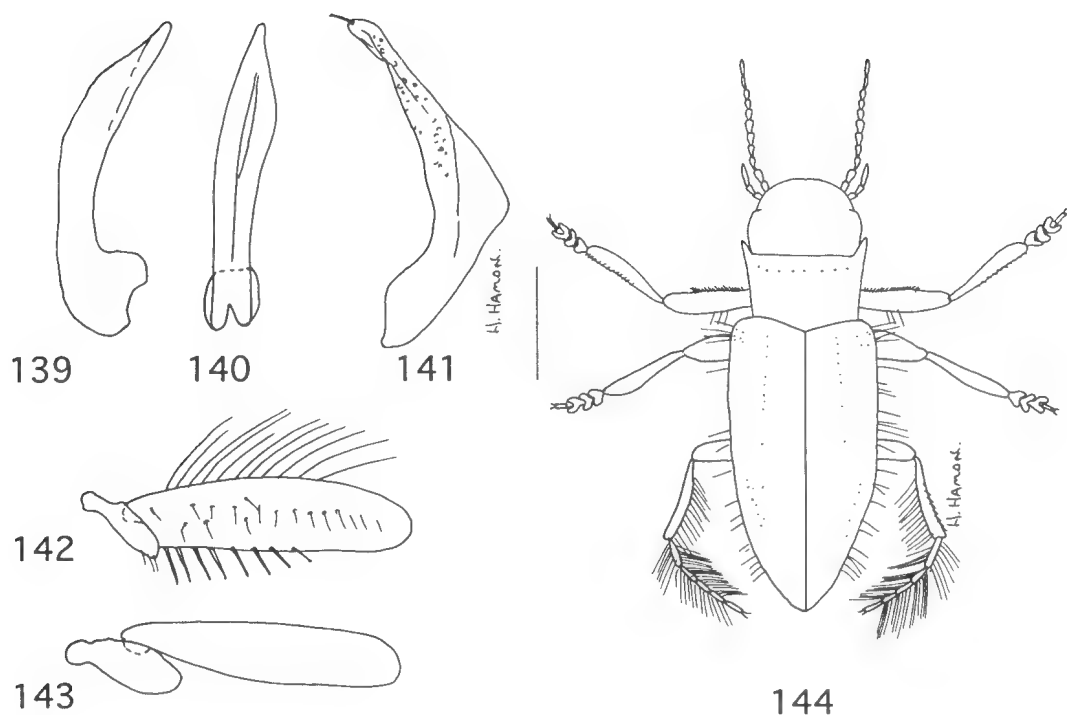
Habitus. Length 3.6–3.8 mm; elongate, relatively flat, slightly depressed in sutural region, weakly constricted at junction of pronotum/elytra; uniformly light testaceous; hindwing vestigial, reduced to tiny flap.

Head. A little narrower than elytra; smooth, moderate reticulation with very small even meshes, a few scattered small punctures; sides subparallel in posterior half; eye remnant reduced to a small suture in middle near anterior edge. Antenna thin, segments 1 and 2 cylindrical, segment 3 about same length as segment 2 but much narrower, segment 4 a little shorter, segments 5 to 9 broader with narrow bases, segment 6 widest, segment 11 1.5 times length of segment 10. Maxillary palpus elongate, segment 4 a little longer than segment 3.

Pronotum. A little narrower than elytra; anteriolateral angles projecting strongly forward; sides slightly converging towards rear, weakly constricted just before base, posterolateral angles obtuse; weakly reticulate, virtually impunctate except for a row of strong punctures along front margin; long setae at sides in anterior third; moderately strongly reticulate with very small even meshes.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, almost parallel-sided, smooth, covered with fine reticulation; virtually impunctate except for a few moderate sized punctures with long setae, more frequent towards sides; underside of elytron with dense setiferous micropunctures towards apex. Epipleuron very weakly differentiated from rest of elytron, that part of elytra visible ventrally very broad along almost the entire length of elytron, tightly enclosing body.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching mesothorax, apical half narrowly triangular, tip rounded, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum not produced forward in midline; wings relatively short, very narrow; broadly rounded in midline



FIGURES 139–144. *Nirridessus stegastos*: **139**, lateral view of central lobe of aedeagus; **140**, ditto dorsal view; **141**, paramere; **142**, mesotrochanter and mesofemur; **143**, metatrochanter and metafemur; **144**, dorsal view. Scale bar represents 1 mm (habitus only).

behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct in inner half, indistinct laterally, ventrites 2 and 3 possibly fused, ventrites 4 to 5 mobile, virtually impunctate except for a few long central seta or bunch of long setae; finely reticulate with small even meshes.

Legs. Protibia very narrow, widest just past middle where it is about twice its basal width; protarsi expanded, segment 1 short, broadly triangular, segment 2 about one-half length of segment 1, segment 3 about as long as segment 1 but narrower, deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, relatively stout, about length of segment 3, segments 1 to 3 with dense covering of adhesive setae; claws short and simple. Mesotrochanter elongate, bluntly pointed, with a few fine setae at apex; mesofemur with row of nine strong spines along hind edge in basal two-thirds; mesotarsi a little narrower and more

elongate than protarsi. Metatrochanter moderately large, elongate/oval apex rounded; metafemur elongate, lacking spines; metatibia weakly curved, widening slightly towards apex; metatarsi elongate, segment 1 longest, segment 4 shortest, in combination segments 1 and 2 slightly shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

Male. Middle segments of antenna a little more expanded than in the female. Median lobe of aedeagus narrow, narrowing in apical quarter; paramere narrowing in apical half, apex rounded (Figs 139–141).

Etymology

Latin. 'Stegastos' – enclosed; a reference to the enclosing elytra.

Remarks

A relatively large well chitinised species with the elytra wrapping around the abdomen for most of its length.

Nirripiriti wedgeensis sp. nov.*Types*

Holotype: m: 'BES 8066, NT: Central Mt Wedge Station, bore RN 15504 at Coppocks Bore, 22°46'24"S 132°06'50"E, 17/6/2001, coll. W.F. Humphreys & R. Read', NTM I 001178. Slide mounted.

Paratypes: 5, as for holotype, 2 WAM 33817–33818, 3 SAMA.

Description (number examined, 6) Figs 145–150

Habitus. Length 1.2–1.4 mm; elongate, relatively flat, slightly constricted at junction of pronotum/elytra; uniformly very light testaceous; hindwing vestigial, reduced to tiny flap.

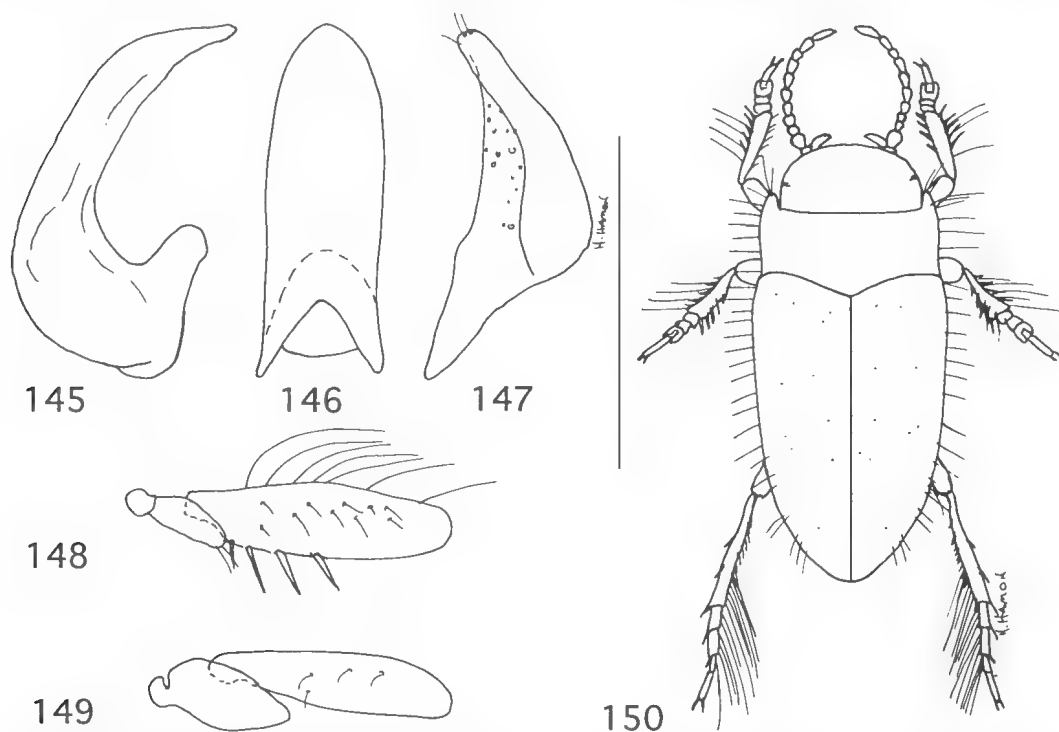
Head. Short, broad, narrower than elytra; smooth, moderate reticulation with small even meshes, virtually impunctate except a few near antennae bases; slightly wider behind; eye remnant reduced to a dark suture in middle near anterior edge. Antenna relatively thick, segment 1 cylindrical, segment 2 broader towards apex, segment 3 much shorter and narrower, segment 4

shorter, segment 5 about same length as segment 3 but wider, segments 6 to 10 subequal, becoming progressively a little narrower, segment 11 about twice length of segment 10. Maxillary palpus stout, segment 4 about twice as long as segment 10.

Pronotum. As wide as elytra; anteriolateral angles projecting strongly forward; base weakly constricted, posterolateral angles acute; moderately reticulate, virtually impunctate except towards front margin.

Elytra. Not fused but tightly closed, lacking inner ridges; elongate, widest near shoulders, smooth, reticulation weak; numerous scattered small punctures; a few additional larger punctures with long setae, more frequent towards sides; underside with numerous setiferous micropunctures at base, apex and along suture line. Epipleuron not differentiated from rest of elytron, that part of elytron visible ventrally broad in anterior quarter, then gradually narrowing to near apex.

Ventral surface. Prosternal process strongly narrowed between coxae, not reaching



FIGURES 145–150. *Nirridessus wedgeensis*: **145**, lateral view of central lobe of aedeagus; **146**, ditto dorsal view; **147**, paramere; **148**, mesotrochanter and mesofemur; **149**, metatrochanter and metafemur; **150**, dorsal view. Scale bar represents 1 mm (habitus only).

mesothorax, apical half broad, spatulate, strongly arched in lateral view with highest point (viewed ventrally) between coxae. Mesocoxae in contact at midline. Metasternum sharply pointed in front in midline; wings absent; broadly triangular in midline behind. Metacoxal plates large, metacoxal lines absent; virtually impunctate; closely adpressed to first abdominal ventrite. Ventrites 1 and 2 fused, sutural lines distinct, ventrites 3 to 5 mobile, virtually impunctate except for a few long central setae or bunch of long setae.

Legs. Profemur broad; protibia narrow, widest near apex where it is about three times its basal width; protarsi expanded, segment 1 broadly triangular, segment 2 about one-half length of segment 1, segment 3 as long as segment 1,

deeply bifid, segment 4 very small and hidden within lobes of segment 3, segment 5 narrow, cylindrical, about length of segment 3, segments 1 to 3 with covering of adhesive setae; claws short and simple. Mesotrochanter elongate with a few fine setae at apex; mesofemur with row of four to five strong spines along hind edge in basal half; mesotarsi a little less expanded than protarsi. Metatrochanter relatively large, tip well separated from metafemur, bluntly pointed; metafemur elongate, lacking spines; metatibia curved, approximately the same width throughout; metatarsi elongate, segments 1 and 5 longest, subequal, segments 1 and 2 in combination much shorter than others, segments 2 to 5 without spines other than at apex; claws weak.

TABLE 1. The distribution of stygal species of dytiscids amongst discrete calcrete bodies in the Yilgarn district of Western Australia and the Ngalia Basin in the Northern Territory. The separate palaeodrainage systems (Fig. 151) and the Indian Ocean (Western) and inland drainages are indicated.

Calcrete	Palaeovalley	Species 1
WESTERN DRAINAGES		
1, Cue	Murchison	<i>Tjirtudessus magnificus</i>
2, Austin Downs	Murchison	<i>Tjirtudessus challaensis</i>
3, Challa North	Murchison	<i>Tjirtudessus challaensis</i>
4, Killara	Murchison	<i>Nirripiri killaraensis</i> sp. nov.
5, Windimurra	Murchison	<i>Tjirtudessus</i> sp. 1
6, Karalundi	Murchison	<i>Tjirtudessus karalundiensis</i> sp. nov.
7, Three Rivers Station	Gascoyne	<i>Bidessodes gutteridgei</i> sp. nov.
8, Milgun Station	Gascoyne	<i>Nirripiri hamoni</i> sp. nov.
9, Lander Station	Gascoyne	
INLAND DRAINAGES		
10, Paroo	Carey	<i>Tjirtudessus eberhardi</i>
11, Lake Violet	Carey	<i>Tjirtudessus wilunaensis</i> sp. nov.
12, Uramurdah Lake	Carey	<i>Tjirtudessus hahni</i>
13, Hinkler Well	Carey	<i>Tjirtudessus hinkleri</i>
14, Mount Windarra	Carey	<i>Tjirtudessus windarraensis</i>
15, Melrose Station (Lake Darlot)	Carey	<i>Nirripiri darlotensis</i> sp. nov.
16, Depot Springs	Raeside	<i>Tjirtudessus fridaywellensis</i>
17, Pinnacles Stn	Raeside	<i>Tjirtudessus pinnaclesensis</i>
18, Lake Mason	Raeside	<i>Tjirtudessus raesideensis</i>
19, Yuinmery	Raeside	<i>Tjirtudessus yuinmeryensis</i> sp. nov.
20, Jundee	Carnegie	<i>Tjirtudessus jundeeensis</i> sp. nov.
21, Cunyu: Sweetwaters	Nabberu	<i>Tjirtudessus cunyuensis</i> sp. nov.
22, Cunyu: SBF	Nabberu	<i>Tjirtudessus bialveus</i> sp. nov.
23, Napperby	Ngalia Basin: NT	<i>Nirripiri macrocephalus</i> sp. nov.
24, Newhaven	Ngalia Basin: NT	<i>Nirripiri newhavenensis</i> sp. nov.
25, Central Mount Wedge	Ngalia Basin: NT	<i>Nirripiri wedgeensis</i> sp. nov.

Male. Little external difference from female. Median lobe of aedeagus broad, bluntly pointed; paramere triangular (Figs 145–147).

DISCUSSION

Etymology

Named after Central Mount Wedge pastoral station where it was collected.

Remarks

A very small almost parallel-sided species with the base of the elytra noticeably wider than the pronotum, which is only slightly constricted. Separated from the slightly larger *N. newhavenensis* from an adjacent calcrete by the weakly constricted pronotum.

Associated fauna

The faunas associated with the Dytiscidae are largely unworked at this stage with only the Copepods having been studied in detail. Hence, only an indication of the associated fauna is given here. As is typical of stygofaunas, the associated fauna is predominantly Crustacean including Bathynellacea (Syncarida), Crangonyctoidea, Ceinidae and Bogidiellidae (Amphipoda), Oniscidea (Isopoda, including *Haloniscus* spp.), Cyclopoida: Cyclopidae; Harpacticoida: Diosacchidae, Ameiridae, Canthocamptidae

Species 2	Species 3	Species 4
<i>Tjirtudessus cueensis</i>		
<i>Tjirtudessus cueensis</i>	<i>Tjirtudessus bigbellensis</i>	<i>Tjirtudessus</i> sp. 3
<i>Tjirtudessus</i> sp. 2		
<i>Nirripiri skaphites</i> sp. nov.	<i>Nirripiri stegastos</i> sp. nov.	
<i>Bidessodes limestoneensis</i> sp. nov.	<i>Nirripiri hamoni</i> sp. nov.	<i>Nirripiri plutonicensis</i> sp. nov.
<i>Nirripiri milgunensis</i> sp. nov.		
<i>Tjirtudessus pulpa</i>	<i>Kintingka kurutjutu</i>	
<i>Tjirtudessus morgani</i>		
<i>Tjirtudessus morgani</i>		
Undescribed		
<i>Tjirtudessus lapostae</i>		
<i>Nirripiri melroseensis</i> sp. nov.		
<i>Nirripiri hinzeae</i>		
<i>Nirripiri fortisspina</i> sp nov	<i>Nirripiri</i> . Undescribed sp.	? <i>Nirripiri</i> larvae
<i>Tjirtudessus masonensis</i>		
<i>Tjirtudessus silus</i> sp nov.	<i>Tjirtudessus sweetwatersensis</i> sp nov.	
<i>Tjirtudessus macrotarsus</i> sp nov.		
<i>Nirripiri napperbyensis</i> sp nov.		
<i>Tjirtudessus pentameres</i> sp nov.		

TABLE 2. Physicochemical environment recorded for various species of stygal Dytiscidae in the genera *Bidessodes*, *Nirripierti* and *Tjirtudessus*. A single value or a range of values given. Note that the environment of all sites has not been recorded.

Species	Conductivity (mS cm ⁻¹)	Temp. (°C)	pH	DO (mg L ⁻¹)	Depth to/ of water	Calcrete
<i>B. gutteridgei</i>	2.38–3.54	25.1–26.6	7.18–7.96	–	5–6/7–40	Three Rivers
<i>B. limestoneensis</i>	2.38	25.1	7.55	–	–	Three Rivers
<i>N. darlotensis</i>	13.2	25.8	7.70	5.05	–	Melrose
<i>N. fortisspina</i>	13.37	23.6	7.43	2.67	–	Pinnacles
<i>N. hamoni</i>	1.66	25.1	7.78	–	?/0.5	Three Rivers
<i>N. killaraensis</i>	3.24	19.6	–	–	–	Killara calcrete
<i>N. macrocephalus</i>	–	–	–	–	–	Napperby, NT
<i>N. melroseensis</i>	13.2	25.8	7.70	5.05	?/0.5	Melrose
<i>N. milgunensis</i>	1.66	25.1	7.78	–	?/0.5	Three Rivers
<i>N. napperbyensis</i>	–	–	–	–	–	Napperby, NT
<i>N. newhavenensis</i>	1.98	25.1	–	–	2.67/?	Newhaven, NT
<i>N. pentameres</i>	–	–	–	–	–	Newhaven, NT
<i>N. plutonicensis</i>	1.82–11.49	25.0–26.6	7.14–7.96	–	3.5–5/11–40	Cunyu SBF
<i>N. wedgeensis</i>	7.11	24.7	–	–	2.5/10	Central Mount Wedge, NT
<i>T. bialveus</i>	6.63–11.49	25.2–26.4	7.32–7.50	–	3.5/10	Cunyu SBF
<i>T. cunyuensis</i>	8.55	17.2	8.30	–	8/0.5	Cunyu Sweetwater
<i>T. jundeeensis</i>	–	–	–	–	7/0.3	Jundee
<i>T. macrotarsus</i>	6.63	25.2	7.32	–	3.5/9.5	Cunyu SBF
<i>T. silus</i>	8.55	17.2	8.30	–	8/0.5	Cunyu Sweetwater
<i>T. sweetwatersensis</i>	8.55	17.2	8.30	–	8/0.5	Cunyu Sweetwater
<i>T. wilunaensis</i>	2.88	18.7	7.30	–	–	Millbillillie
<i>T. yuinmeryensis</i>	9.39–15.4	21.9–22.2	7.27–7.63	5.22–5.44	2.5/1	Yuinmery

Parastenocaridae (Copepoda) and Ostracoda. Hydrobiidae (Gastropoda) are important associates in the Ngalia Basin of the Northern Territory (Table 3); however, in the Western Fortescue Plains aquifer in the Pilbara, they occur with Spelaeogriffacea but no Dytiscidae are present (Poore & Humphreys 1998). Karanovic (2003) recently described four new genera and eight species in five families of Copepoda from the Yilgarn region of Western Australia collected as part of this study. Those indicated in Table 3 were directly associated with the dytiscids collected here. Several species of *Haloniscus* occur in some aquifers (Taiti & Humphreys 2001).

Site characteristics and water quality

As in previously reported work on Australian stygal Dytiscidae, samples were collected from a range of types of access into the groundwater calcrete aquifers (Table 1, Fig. 151), including: monitoring wells in working water borefields, sometimes within metres of functioning pumps; piezometers; aquifer exploration bores; uncased mineral exploration bores; pastoral bores; and

hand dug pastoral wells, some of which would have been enlarged traditional watering places (Table 2).

Some of the sites containing stygal dytiscid are quite saline (22 g L⁻¹ or greater) (Watts & Humphreys 2000) whereas others meet salinity standards for drinking water. Groundwaters in the Australian arid zone typically have high concentrations of nitrates (Jacobson 1993); those recorded in this study had a mean value of 80 mg L⁻¹ nitrate (range 0–250 mg L⁻¹; Fig. 154).

Profiling various groundwaters in the Yilgarn has not only exposed a great variety of waters but has also shown that closely adjacent sites are often quite different, revealing considerable heterogeneity of groundwater (Table 4; Fig. 153).

Hydrogen sulphide is sometimes encountered in the water (or disturbed from the sediments). At Alice Well in the Austin Downs calcrete, greater than 10 ppm H₂S was recorded, far higher even than that recorded in anchialine systems containing profuse sulphur bacteria colonies (Humphreys 1999a,b).

The distribution of the groundwater fauna and

TABLE 3. Stygofauna associated with collection of various species of stygal Dytiscidae in the genera *Bidessodes*, *Nirripiriti* and *Tjirtudessus* reported in this paper. Column numbers denote: 1, Syncarida; 2, Amphipoda; 3, Crangonyctoidea; 4, Ceinidae; 5, Bogidiellidae; 6, Isopoda: Oniscidea; 7, Copepoda; 8, Harpacticoida; 9, Cyclopoida; 10, Ostracoda; 11, Other; 12, Dytiscidae; 13, Calcrete.

Species numbers denoted in column 7 Cyclopoda: Cyclopidae: Cyclopidae: *Halicyclops* *brooksi* Pesce Laurentiis & Humphreys 1996; 4, *Metacyclops laurentiisae* Karanovic 2003; 5, *Fiersicyclops fiersi* Humphreys 2001; Cyclopinae: 3, *Mesocyclops brooksi* Pesce Laurentiis & Humphreys 1996; 4, *Metacyclops laurentiisae* Karanovic 2003; 5, *Fiersicyclops fiersi* (Laurentiis Pesce & Humphreys 2001); 6, *Microcyclops varicans* (Sars 1863); 7, *Goniocyclops uniauricularis* Karanovic 2003; 8, *Goniocyclops mortoni* Karanovic 2002; Harpacticoida: Diosaccidae: 9, *Schizopera austindownsi* Karanovic 2003; 10, *Schizopera jundeei* Karanovic 2003; Ameiridae: Ameirinae: 11, *Nitokra lacustris pacifica* Yeatman 1983; 12, *Haifaemeta pori* Karanovic 2003; Canthocamptidae: 13, *Australocamptus similis* Karanovic 2003.

	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Bidessodes gutteridgei</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>B. limestoneensis</i> ; <i>N. plutonicensis</i>	Three Rivers
<i>Bidessodes limestoneensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>B. gutteridgei</i> ; <i>N. plutonicensis</i>	Three Rivers
<i>Nirripiriti darlotensis</i> sp. nov.	•	•	•	•	•	•	2, 11	•	•	•	•	•	Melrose Station
<i>Nirripiriti fortissipina</i> sp. nov.	•	•	•	•	•	•	2, 3	•	•	•	•	•	Pinnacles
<i>Nirripiriti hamoni</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>N. milgunensis</i>	Three Rivers
<i>Nirridessus karalundiensis</i> sp. nov.	•	•	•	•	•	•	4,	•	•	•	•	•	Karalundi
<i>Nirripiriti killaraensis</i> sp. nov.	•	•	•	•	•	•	2, 6, 8	•	•	•	•	•	Killara
<i>Nirripiriti macrocephalus</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>N. napperbyensis</i>	Napperby
<i>Nirripiriti melroseensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>N. darlotensis</i>	Melrose
<i>Nirripiriti milgunensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>N. hamoni</i>	Milgun
<i>Nirripiriti napperbyensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>N. macrocephalus</i>	Napperby
<i>Nirripiriti newhavenensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	•	Napperby
<i>Nirripiriti pentameres</i> sp. nov.	•	•	•	•	•	•	•	•	•	#1	•	<i>B. limestoneensis</i> ; <i>B. gutteridgei</i> ;	Newhaven
<i>Nirripiriti plutonicensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>N. plutonicensis</i> ;	Three Rivers
<i>Nirripiriti wedgeensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	#2	•	•	Central Mount Wedge
<i>Tjirtudessus bialveus</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>T. macrotarsus</i>	Cunyu SBF
<i>Tjirtudessus cunyuensis</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>T. sweetwatersensis</i> ; <i>T. silus</i>	Cunyu Sweetwaters
<i>Tjirtudessus jundeeensis</i> sp. nov.	•	•	•	•	•	•	1, 10,	•	•	•	•	•	Jundee
<i>Tjirtudessus macrotarsus</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>T. bialveus</i>	Cunyu SBF
<i>Tjirtudessus silus</i> sp. nov.	•	•	•	•	•	•	•	•	•	•	•	<i>T. cunyuensis</i> ; <i>T. sweetwatersensis</i>	Cunyu Sweetwaters
<i>Tjirtudessus sweetwatersensis</i> sp. nov.	•	•	•	•	•	•	4, 9	•	•	•	•	<i>T. cunyuensis</i> ; <i>T. silus</i>	Cunyu Sweetwaters
<i>Tjirtudessus wilunensis</i> sp. nov.	•	•	•	•	•	•	1, 5, 7, 12, 13	•	•	•	•	•	Lake Violet
<i>Tjirtudessus yuinmeryensis</i> sp. nov.	•	•	•	•	•	•	2, 5,	•	•	•	•	•	Yummier

In column 11: #1, Hydrobiidae: Acarina: *Koenikea*? sp.; Gastropoda: Hydrobiidae aff. *Trochidrobia* n.sp. 1; #2, Gastropoda Hydrobiidae aff. *Trochidrobia* n.sp. 2

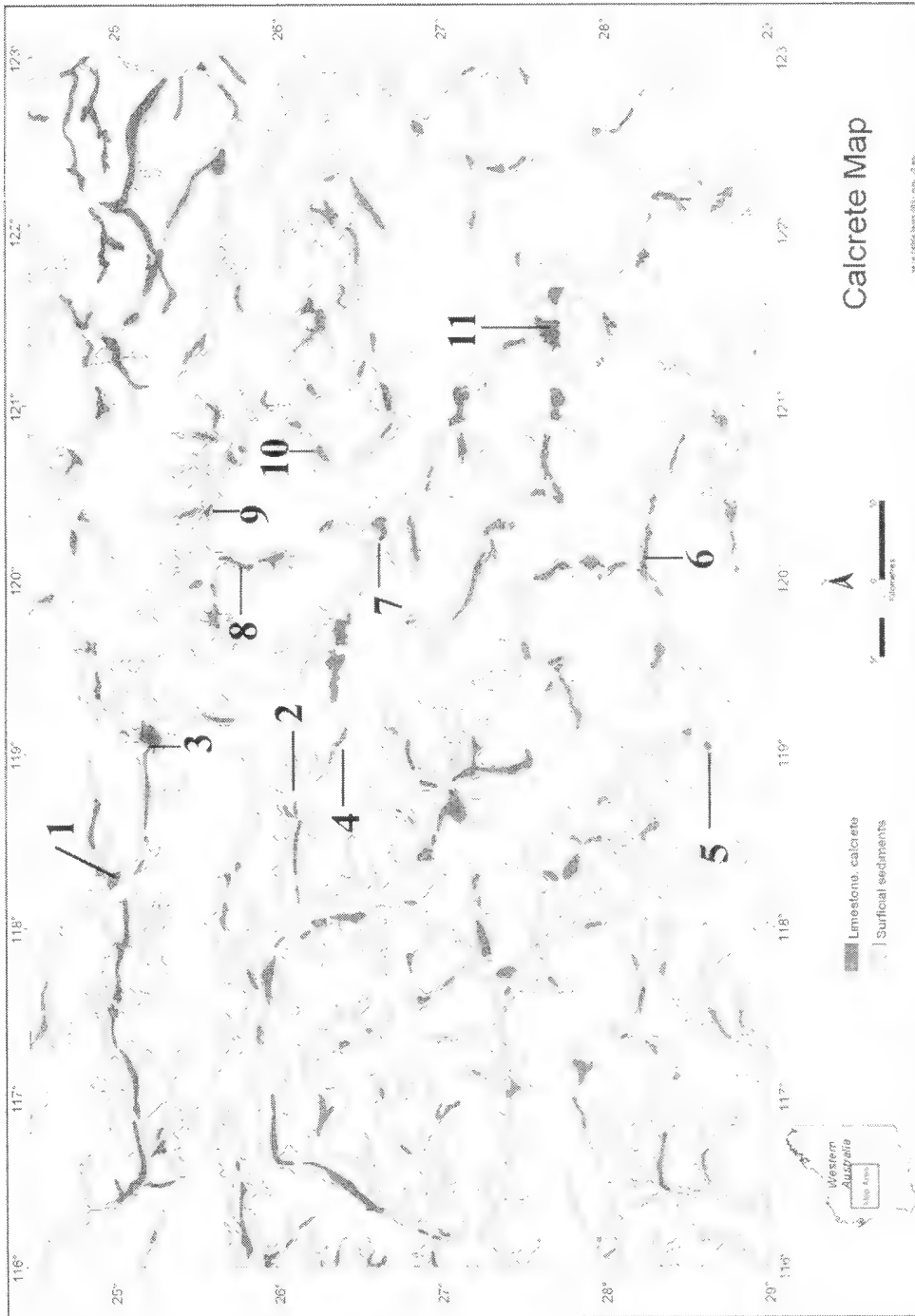


FIGURE 151. The location of calcrete areas (darker shading) and palaeodrainage systems (paler shading) in the Yilgarn region of Western Australia. Numbers proceed from west to east. 1, Milgun calcrete; 2, Karalundi calcrete; 3, Three Rivers calcrete; 4, Killara central calcrete; 5, Yuinmery south calcrete; 6, Pinnacles calcrete; 7, Lake Violet calcrete; 8, Cunyu, State Barrier Fence calcrete; 9, Cunyu, Sweetwaters Well calcrete; 10 Jundee mine calcrete; 11, Melrose (Lake Darlot) calcrete.

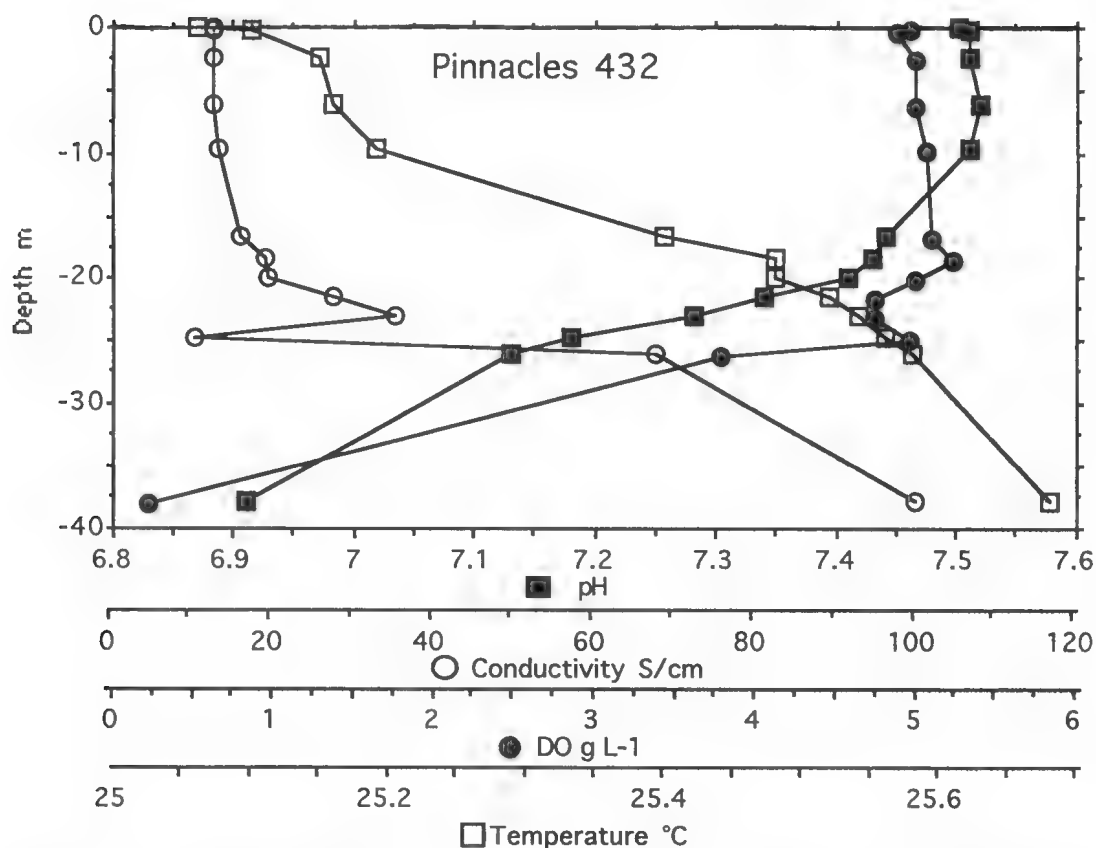


FIGURE 152. Distribution of physicochemical profiles at the Pinnacles, the type locality of *Nirripipti fortisspina* sp. nov.

the physicochemical environment within the calcrete aquifers appear to be quite heterogeneous, both within the groundwater profile and between areas (Figs 152, 153). For example, closely adjacent bores may yield consistently different faunas and have different water quality and profiles (Table 4; Fig. 153). Conversely, waters with different DO profiles may have rather similar faunas and provide no clear relationship between DO concentration and stygofauna (Table 5; Fig. 155). Interpretation of such trends requires a more detailed knowledge of water quality and particularly of the section(s) of the profiles inhabited by the various stygobites. It is possible that attributes other than water quality, in a physicochemical sense, are the determinants of suitability for stygofauna; microbiological characteristics appear to be important determinants of the presence of stygofauna in some German aquifers (H.J. Hahn, pers. comm., 2002).

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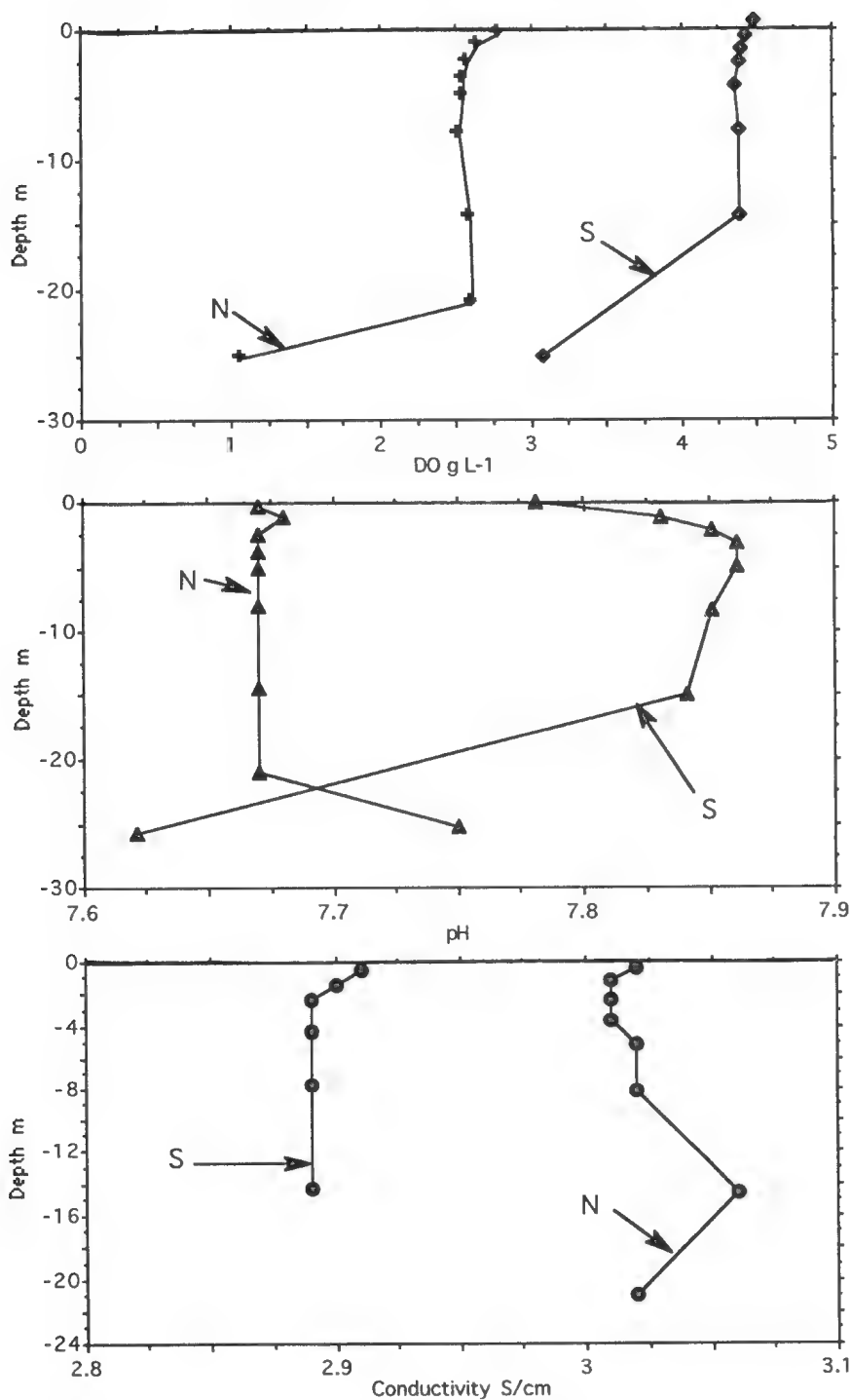


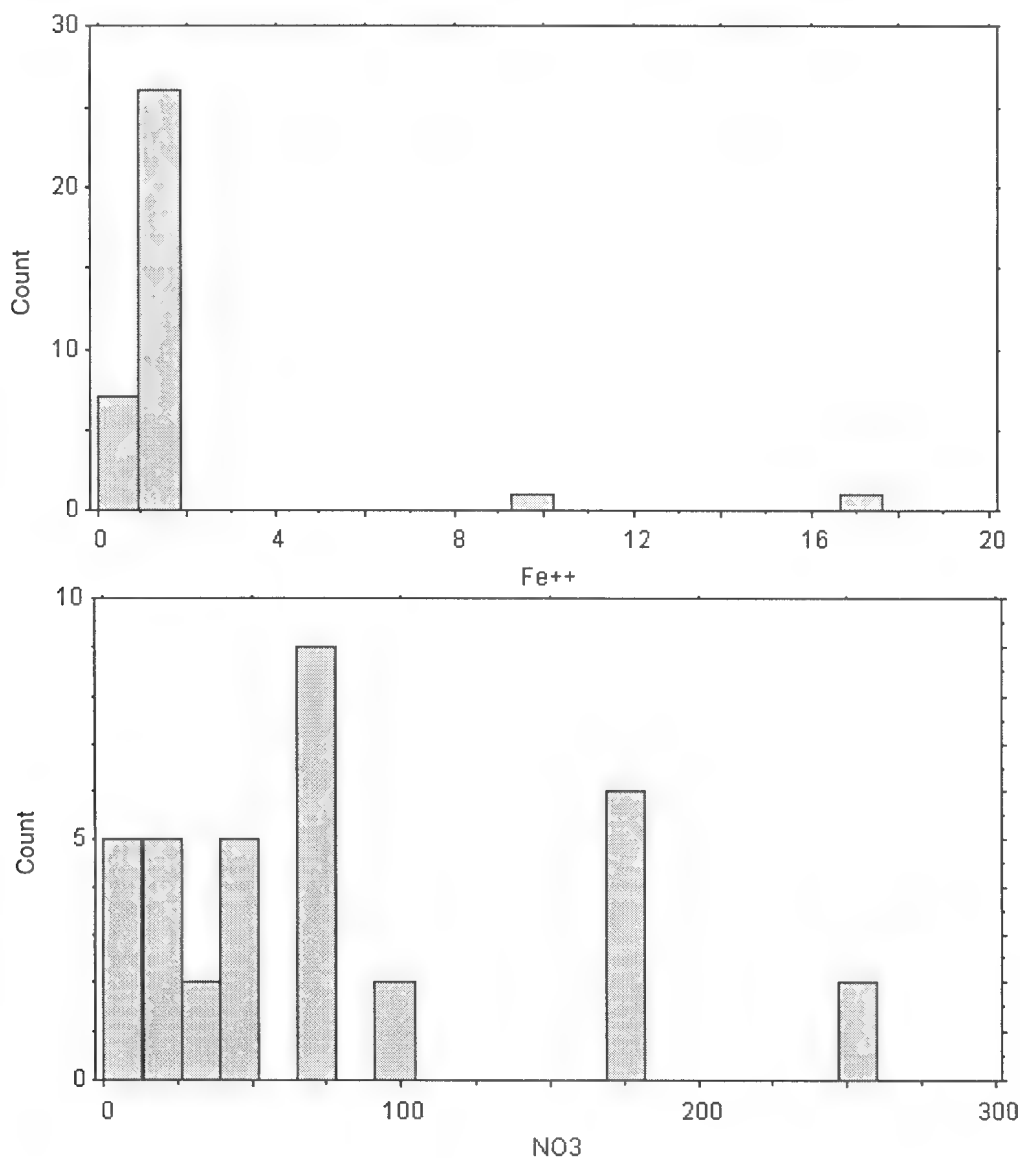
FIGURE 153. Profiles of physicochemical parameters through the water column of bores in the Hinkler calcrete (Table 4). The two bores, denoted N (north) and S (south), were drilled for the Main Roads Department at the same time to supply water and are less than 30 m apart. They have consistently yielded different fauna, even before they were used for water abstraction.

TABLE 4. The distribution of taxa between the two adjacent bores depicted in Fig. 153

Taxon	North	South
Amphipoda	4	3
Bathynellacea	98	431
Dytiscidae	99	5
Copepoda	20	0

TABLE 5. The distribution of taxa between bores in the Lake Violet area, depicted in Fig. 155

Taxon	Pump 1	OB 3	OB 4	OB 5	OB1
Ostracoda	255	—	—	9	66
Amphipoda	16	—	15	—	12
Bathynellacea	2	1	1	2	3
Dytiscidae	8	—	1	—	13
Copepoda	9	3	4	27	47

FIGURE 154. Distribution of iron (II) and nitrate in water samples from the Yilgarn groundwater calcrete samples. Upper: iron (II) (mg L⁻¹ Fe⁺⁺) and lower: nitrate (mg L⁻¹ nitrate)

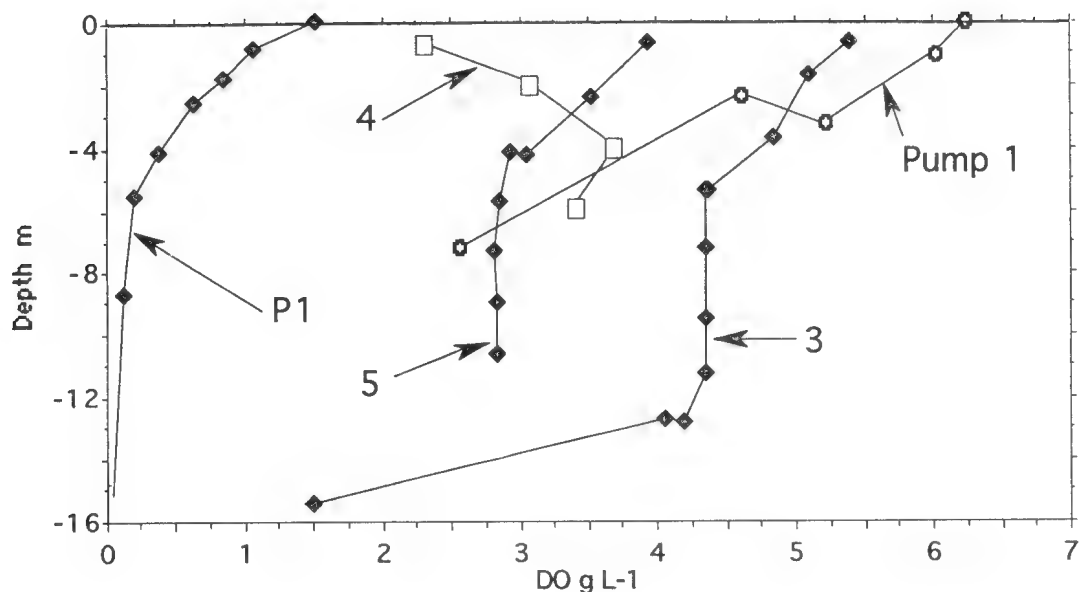


FIGURE 155. The vertical distribution of oxygen in the Lake Violet borefield area, an area of major water abstraction and the type area for *Tjirtudessus wilunaensis* sp. nov. The profiles are all from monitoring bores closely adjacent to an actively pumping well-field. P1 is the observation bore (OB1) for Pump 1 as denoted in Table 5.

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**PROVISIONAL CHECKLIST OF THE ASILIDAE (INSECTA : DIPTERA)
OF SOUTH AUSTRALIA, UTILISING AN UPDATED SUBFAMILY
CLASSIFICATION**

ROBERT J. LAVIGNE

Summary

A provisional checklist of the Asilidae (robber flies) of South Australia is provided. Distribution notes for individual species are provided, where available. The higher classification of the Asilidae, as found in South Australia, is updated.

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LAVIGNE, RJ. 2003. Provisional checklist of the Asilidae (Insecta: Diptera) of South Australia, utilising an updated subfamily classification. *Records of the South Australian Museum* 36(2): 189–194

A provisional checklist of the Asilidae (robber flies) of South Australia is provided. Distribution notes for individual species are provided, where available. The higher classification of the Asilidae, as found in South Australia, is updated.

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The purpose of this paper is threefold: a) to provide currently known distributions of South Australian robber flies (Insecta: Diptera: Asilidae), as recorded in the published literature, and to add to distributions of these predatory flies; b) to provide citations for biological/behavioural information for these same robber flies, where available; and c) to update the classification of South Australian Asilidae in line with recent changes in subfamily classification.

Little is known of the distribution of South Australian robber flies. The first published reference dealing with species from South Australia (SA) appeared in the second volume of the *Transactions and Proceedings and Report of the Philosophical Society of Adelaide, South Australia for 1878-9*. In that volume Otto Tepper (1879) wrote as follows: "The Asilidae and their near allies comprise nineteen species, including the giants of the order, which inhabit Yorke's Peninsula and adjacent parts, and measure one and three quarter inches in length. All are carnivorous." Undoubtedly, he was referring to members of the genus *Phellus*, which are the largest known asilids. Unfortunately, no individual species were listed.

During the 1950s Frank M Hull, author of the two volume definitive work on the asilid genera of the world, visited the SA Museum (SAM). As a result of his visit, he described several species of *Bathypogon* (Hull 1958a, b, c, d, 1959), with the types of the following species being deposited in the SA Museum: *bidentatus* (Holotype), *calabyi* (Holotype), *douglassi* (Holotype), *flavifemoratus*

(Holotype), *ichthyurus* (Holotype), *macrodonturus* (Holotype), *nigrotibiatus* (Holotype), *ochraceus* (Holotype, Allotype, Paratype), *ophiurus* (Holotype), *robustus* (Paratype), *rubidapex* (Paratype), *rufitarsus* (Holotype, Allotype). However, only five of these species were described from South Australian specimens: *calabyi*, *ichthyurus*, *ochraceus*, *ophiurus* and *rufitarsus*.

In his extensive taxonomic revision of the widespread Australian tribe Chrysopogonini, Clements (1985) was only able to record seven species (out of 49, representing four genera) as occurring in South Australia. Clements (pers. comm.), however, did not access the SA Museum collection. Similarly, Daniels (1987), in his revision of *Neoaratus* Ricardo with descriptions of six allied new genera (58 species), recorded only four species from South Australia.

In 1989 Daniels published the Family Asilidae, as part of the Catalog of the Diptera of Australasia and Oceanic Regions, a version of which may be accessed on the internet (<<http://hbs.bishopmuseum.org/aocat/asilidae.html>>). In it he recorded 36 species from South Australia, without, however, providing data on their distribution or indicating the basis for noting their occurrence in SA. A search of the SA Museum collection in July–August 2002 failed to reveal any specimens other than types which had been identified by Daniels. Subsequently, in September 2002, a visit was made to Melbourne to examine Daniels's extensive personal asilid collection to see if it contained specimens from South

Australia, other than the collection made by RJ Lavigne in 1978–79 which is contained therein. During the visit, it was determined that much of the material noted as occurring in South Australia had been loaned to Daniels by the SA Museum. Specimens had been identified, data recorded and the specimens returned without identity labels. This has now been rectified. Daniels kindly provided access to his ledger and database so that I might obtain SA records. It should be noted however that, because of the infant state of Australian asilid taxonomy, many of the SA specimens in his collection were only identified to genus. Consequently, only data dealing with identified species has been incorporated into this preliminary checklist.

Little has been accomplished in enumerating the biology/behaviour of South Australian Asilids. A start was made by Lavigne (1982a,b, 1984, 1992) in which the behaviour of three species of *Cerdistus*, a species of *Neoscleropogon*, a species of *Neocerdistus*, two species of *Colepia* and a species of *Mauropteron* were described, but nothing more has since been published.

The classification of asilid subfamilies used in this paper is an interim one based upon the recent published works of Papavero (1973), Artigas & Papavero (1988), and Lehr (2001). As pointed out by Fisher and Wilcox (unpublished), such a classification scheme provides a more uniform system and appears to be a distinct improvement over previous classification schemes. It is obvious to many systematists that all available classifications of Asilidae are flawed (principally by a general lack of rigorous phylogenetic analysis): and that it is to be expected that many changes will be made as a result of future studies.

In 1878–79 only four subfamilies were recognised: Asilinae, Dasyopogoninae, Laphriinae and Leptogastrinae (Tillyard 1926). Daniels (1989) still only recognised the same four subfamilies as occurring in the Australasian and Oceanic region. Over the years the higher taxonomy of the Asilidae has evolved considerably, with new families being established or tribes (as used by Daniels 1989) being elevated to the status of subfamily, representatives of ten of which are known to occur in Australia: Apocleinae (Papavero 1973), Atomosiini to Atomosiinae (Lehr 1977), Dioctriini to Dioctriinae (Lehr 2001), Laphystini to Laphystinae (Papavero 1973), Ommatiini to Ommatiinae (Ricardo 1929), Stenopogonini to Stenopogoninae (Paramonov 1966) and Stichopogonini to Stichopogoninae (Artigas & Papavero 1988).

Worldwide, 13 subfamilies are now considered valid by many authors: Apocleinae, Asilinae, Atomosiinae, Dasyopogoninae, Dioctriinae, Laphriinae, Laphystinae, Leptogastrinae, Megapodinae, Ommatiinae, Stenopogoninae, Stichopogoninae and Trigonominae.

The following checklist contains data on 52 species, representing 6 subfamilies and 21 genera, the names of which have appeared in the published literature over the last 123 years. On the basis of this census, there has been an increase of, at least, 33 named species in South Australia since Tepper's original paper; however, it is unclear how many species Tepper considered to be robber flies and how many to be carnivorous allies of the Asilidae. This listing by no means represents the total number of asilid species to be found in South Australia, but stands as a base for an enlarged checklist that will be based on material being currently identified and stored in the SAM insect collection, as well as material that is being acquired by survey teams. Daniels (pers. comm. 2002) has suggested that, based on his studies, there are well over 100 undescribed species of *Bathypogon* alone, Australia-wide.

Within the checklist are included notations of SA specimens identified by Daniels but which are deposited in other museums. These abbreviations used are as follows: AM – Australian Museum, Sydney; ANIC – Australian National Insect Collection, Canberra; BMNH – British Museum of Natural History; GDC – Greg Daniels Collection; OX – Oxford University (Hope Collections); WARI – Waite Agricultural Research Institute, Adelaide.

CHECKLIST

Apocleinae

Blepharotes coriarius Wiedemann, 1830 [Daniels 1989] [Daniels, pers. comm.: Adelaide (WARI). 25 Jan]

Blepharotes flavus Ricardo, 1913b [Daniels 1989] [Daniels, pers. comm.: Adelaide; Parakalyia Bore, Everard Pk. Stn., Port Lincoln. 2 Nov]

Asilinae

Asiola lemniscata Daniels, 1977 [Daniels 1989] [Daniels 1977: 48. Paratypes: Immarna; Kimba; Nundroo (Homestead), 5 mi W. 20–28 Oct] [Daniels, pers. comm.: Maya, 2 mi S.]

Cerdistus armatus (Macquart, 1846) [Lavigne 1982a (ethology, as *Neoitamus armatus*)]

- [Lavigne 1982a: 625. Aldinga Beach; Ferries-McDonald Conservation Park, S of Monarto. 11 Dec – 31 Jan]
- Cerdistus exilis* (Macquart, 1838) [Hardy 1935b (as *Asilus exilis*): 415. Kangaroo Isl. (South Australia)] [Daniels 1989]
- Cerdistus margitis* (Walker, 1849) [Lavigne 1982a (ethology, as *Neoitamus margites*)] [Lavigne 1982a: 625. Ferries-McDonald Conservation Park, S of Monarto; Mortlock Exp. Stn., Auburn; 3.3 km S of Echunga; 8 km ENE of Callington. 11 Dec – 1 Mar. Lavigne 1982a]
- Cerdistus neoclaripes* Hardy, 1921 [Hardy 1935b (as *Neoitamus neoclaripes*): 415. "South Australia", no date] [Daniels 1989]
- Cerdistus rufometatarsus* (Macquart, 1855) [Hardy 1935b (as *Asilus rufometatarsus*): 416. Adelaide (South Aust.), no date] [Daniels 1989]
- Cerdistus rusticanoides* Hardy, 1926 [Hardy 1935b: 410. "South Australia", no date] [Daniels 1989]
- Cerdistus setifemoratus* (Macquart, 1855) [Daniels 1989]
- Cerdistus vittipes* (Macquart, 1847) [Lavigne 1982a (ethology, as *Neoitamus vittipes*)] [Lavigne 1982a: 617–18. Adelaide; Keyneton, 4.5 km E; Kapunda, 2.7 km S, bank of Light River; Kingston, 16 km N; Milang, 12 km SE, 3 & 8 km E, 10 km S; Morgan, 11.6 km NW; Port Gawler; Port Wakefield. 23 Nov – 27 Mar] [Daniels, pers. comm.: Adelaide (GDC); Virginia, ca. 6 km SW. 25 Nov – 1 Feb]
- Colepia abludo* Daniels, 1983 [Daniels 1983 (as *Neoaratus abludo*): 233. Aldinga, 8.2 km S; Aldinga Beach; Elizabeth; Hammond; Lyndoch; Mortlock Exp. Station, Auburn. 30 Dec – 24 Jan] [Lavigne 1992 (ethology, as *Neoaratus abludo*); Lawson & Lavigne 1984 (description of eggs)] [Daniels 1989 (as *Colepia*)]
- Colepia ingloria* (Macleay, 1826) [Hardy 1935a (as *Neoaratus ingloria*): 182. "South Australia", no date] [Daniels 1987 (biology, pupal description)]
- Colepia rufiventris* (Macquart, 1838) [Hardy 1935a (as *Neoaratus rufiventris*): 185. "South Australia", no date] [Daniels 1987 (biology, pupal description); Daniels 1989; Lavigne 1992 (ethology, as *Neoaratus rufiventris*)] [Daniels 1987: 500. Belair; Blackwood; Bridgewater; Engelbrook Reserve; Ferries-McDonald Conservation Park; Hawthorndene; Lobethal; Paracombe; Tailem Bend; Tooborag, nr. Adelaide; Victory; Waitpinga, no dates] [Lavigne 1992: 261. Kingston, 16 km N, opp. Coorong Game Reserve; Mt Barker. 18 Dec – 2 Mar] [Daniels, pers. comm.: 1 Jan – 7 Mar]
- Mauropteron pelago* Daniels, 1987 [Ricardo 1913b (as *Asilus pelago*): 443. Adelaide, no date] [Hardy 1935a (as *Neoaratus pelago*): 186. "South Australia", no date] [Daniels 1987 (biology): 510. Adelaide; Balgowan, 4 km NE, nr. Maitland; Benif Station, Coorong; Ferries-McDonald Conservation Park; Flinders Isl.; Iron Baron; Kingston, South-East; Lowan Station, 4 mi S of Sherlock; Port Lincoln; Purnong, nr. Murray Bridge; Seal Bay, Kangaroo Isl.; Sedan, 5 km W; Sleaford Bay; Whyalla; Winceby Isl., no dates] [Daniels 1989] [Lavigne 1992 (ethology, as *Neoaratus pelago*): 261. Ferries-McDonald Conservation Park; Sedan, 5 km W. 4 Dec – 5 Feb] [Daniels, pers. comm.: Kimba, 32 km E; Nullarbor. 4 Dec – 4 Apr]
- Neoaratus hercules* (Wiedemann, 1828) [Daniels 1987 (biology, pupal description): 513 [Castle Hill, Kangaroo Isl.; Fleurieu Peninsula; Kingscote, Kangaroo Isl.; Mt Lofty; Reedy Creek, SE South Aust.; Tanunda, Upper Sturt; Adelaide, no dates] [Daniels 1989] [Daniels, pers. comm.: Norton Summit, nr Ashton; Westridge (ANIC). 18 Nov – 21 Jan]
- Neocerdistus acutangulatus* (Macquart, 1847) [Lavigne 1984: 422. One Tree Hill, E of Elizabeth, nr. Para Wirra National Park. 5 – 30 Apr] [Lavigne 1984 (ethology); Daniels 1989]
- Neoitamus mistipes* (Macquart, 1850) [Ricardo 1913b: 433. Mt. Gambier, S. Australia, no date] [Daniels, pers. comm.: Mt Compass, Cox's Scrub Nat. Pk., 12 km SE. 20 Jan]
- Dasypogoninae**
- Apothechyla carbo* (Walker, 1851) [Hardy 1934b (as *Rachiopogon carbo*): 23. "South Australia", no date]
- Brachyrhopala* (*Brachyrhopala*) *quadricincta* Bigot, 1879 [Clements 2000: 87. Horrocks Pass, SE of Port Augusta, no date]
- Chryseutria amphibola* Clements, 1985 [Clements 1985: 82. Holotype ♀, Paratype ♀, Emu Field, 300 mi NW of Woomera. Sept – Oct 1953] [Daniels 1989]
- Chrysopogon agilis* Clements, 1985 [Clements 1985: 8. "S Australia"] [Daniels 1989]

Chrysopogon albosetosus Clements, 1985 [Clements 1985: 21. Mt Serle, Flinders Ranges, no date] [Daniels 1989]

Chrysopogon castaneus Clements, 1985 [Clements 1985: 29. "S. Aust.", no date] [Daniels 1989]

Chrysopogon pellos Clements, 1985 [Clements 1985: 58. Holotype ♂, Marla Bore, 30 mi W of Melbourne Hills Homestead. 23 Mar] [Daniels 1989]

Chrysopogon pilosifacies Clements, 1985 [Clements 1985: 60. Koonalda, 14 mi E. 17 Oct] [Daniels, pers. comm.: Fisher E-W Line (AM); Port Augusta, SE of Horrocks Pass. 21 Nov] [Daniels 1989]

Chrysopogon rubidipennis White, 1918 [Clements 1985: 65 [SA "no locality"]] [Daniels 1989]

Chrysopogon trianguliferus Clements, 1985 [Clements 1985: 72. Curnamona Station, Yunta Highway, 7 mi N turn to Erudina Woolshed, Wirrealpa Station, 1 km N Marshals Corner Bore. 17 – 19 Feb] [Daniels 1989]

Dakinomyia froggattii Dakin & Fordham, 1922 [Daniels, pers. comm.: Nullarbor roadhouse, 183 km W. 23 Jan] [Daniels 1989]

Questopogon affinis Daniels, 1976 [Daniels, 1976: 229. Kimba, no date, E. Broomhead, Paratype ♀] [Daniels 1989]

Thereutria amaraca (Walker, 1849) [Daniels 1989] [Daniels, pers. comm.: Wilpena Pound, Flinders Range. 19 – 20 Jan]

Thereutria tessellata (Hardy, 1930) [Daniels 1989] [Daniels, pers. comm.: Milang; Wilpena Pound, Flinders Range. 8 – 19 Jan]

Laphriinae

Laphria rufifemorata Macquart, 1846 [Ricardo 1913a: 155. Bakewell, "S. Australia", no date] [Hardy 1934a: 520. "South Australia", no date]

Laphria telecles Walker, 1849 [Daniels, pers. comm.: Ravine des Cas., Kangaroo Isl. 30 Nov]

Ommatiinae

Ommatius distinctus Ricardo, 1918 [Daniels, pers. comm.: Flinders Isl., northern Arkaroola. 22 Jan]

Ommatius pilosus White, 1916 [Daniels 1989] [Daniels, pers. comm.: Mortlock Exp. Stn., Auburn; Mt Lofty Botanical Gardens. 17 – 31 Jan]

Ommatius queenslandi Ricardo, 1913 [Daniels, pers. comm.: Wilpena Pound, Flinders Range. 19 Jan]

Stenopogoninae

Amphisbetetus trinotatus Paramonov, 1966 [Daniels 1989] [Daniels, pers. comm.: Kalabity H.S., Birthday Rd, 5.6 km N. 15 Feb]

Bathypogon aoris (Walker, 1849) [Ricardo 1912: 153. Adelaide (Ent Club) (type female), no date] [Hardy 1934b: 9. "South Australia", no date. (after Ricardo 1912)] [Daniels 1989] [Daniels, pers. comm.: Adelaide (BMNH)]

Bathypogon calabyi Hull, 1958 [Hull 1958a: 199. Owieandana, N. Flinders Range. Holotype ♂] [Daniels 1989]

Bathypogon chionthrinx Hull, 1958 [Hull 1958c : 161. Kalamunda, no. date. Holotype ♂, Allotype ♀] [Daniels 1989] [Daniels, pers. comm.: Kimba, 32 km E. 21 Jan.]

Bathypogon ichthyurus Hull, 1958 [Hull 1958d: 187. L. Callabonna, no date. Holotype ♂] [Daniels 1989] [Daniels, Pers. Comm.: Lk. Callabonna, no date]

Bathypogon microdonturus Hull, 1958 [Hull 1958d: 190. Owieandana, N. Flinders Range, no date. Holotype ♂] [Daniels 1989]

Bathypogon ochraceus Hull, 1959 [Hull 1959: 18: Owieandana, N. Flinders R, no date. Holotype ♂, Allotype ♀, 4 Paratypes] [Daniels 1989]

Bathypogon ophiurus Hull, 1958 [Hull 1958b: 62. Flinders Isl., no date. Holotype ♂] [Daniels 1989] [Daniels, pers. comm.: Flinders Isl., no date]

Bathypogon rufitarsus Hull, 1958 [Hull 1958b: 64.] Mt Serle, N. Flinders Range. Holotype ♂, Allotype ♀] [Daniels 1989] [Daniels, pers. comm.: Keyneton, 6.4 km E; Monarto; Mt Serle, Flinders Range; Port Wakefield; Virginia, ca. 6 km SW. 23 Nov – 11 Dec]

Bathypogon testaceovittatus (Macquart, 1855) [Hardy 1934b: 8. Adelaide, South Australia] [Daniels 1989] [Daniels, pers. comm.: Adelaide (OX)]

Neoscleropogon agave (Walker, 1849) [Hardy 1928 (as *Stenopogon agave*), Hardy 1934b (as *Stenopogon agave*): 15. "South Australia"]

Neoscleropogon durvillei (Macquart, 1838) [Daniels, pers. comm.: Port MacDonnell. 6 Jan]

Neoscleropogon lanatus (Walker, 1849) [Hardy 1928 (as *Stenopogon lanatus*), Hardy 1934b (as *Stenopogon lanatus*): 14. "South Australia"]

Neoscleropogon macquarti Daniels, 1989 [Ricardo 1912 (as *Neoscleropogon elongatus*): 156. "S. Australia"] [Lavigne 1982b, as *Neoscleropogon elongatus* (ethology)] [Lavigne 1982b: 742–43. Aldinga Beach; Ferries-McDonald Conservation Park, south of

Monarto; Sandy Creek, nr Gawler. 28 Nov – 22 Jan]

Phellus piliferus Dakin & Fordham, 1922 [Barker & Inns 1976 (ethology); Daniels 1989] [Daniels, pers. comm.: Hambridge Conserv. Pk., western boundary; Renmark, 30 mi NNW; Sleaford Bay, Port Lincoln. 23 Jan – 1 Mar]

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